THE PRINCIPLES AND TECHNIQUE OF ORAL SURGERY

BY

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PREFACE

The past five or six years have been marked by a greater amount of research work in oral pathology than any previous period of similar length. The findings have revolutionized our views not only on numerous pertinent problems but also in many respects in regard to the technique and practice of dental and oral surgery. Some lesions to which no special significance has been accorded in the past are now regarded as truly surgical problems. Therefore many pathological conditions, disclosed through the more general use of radiography, and the perfected methods of local anesthesia adapted to this field, have aroused a keener interest in the surgical treatment of diseased conditions about the mouth.

These circumstances and the experience gained in teaching graduates and undergraduates have impressed me with the conception that a book, which would treat, in a concise and comprehensive manner, those pathological and abnormal or anomalous conditions about the teeth and their associated structures which are so frequently encountered in every-day practice, might prove to be of interest to the profession.

This book has not been intended to be an inclusive or complete work on oral surgery. My aim rather has been to present in a more assimilable form those minor and semi-major, more common conditions, together with systematized methods for their surgical relief. With this view in mind I have attempted to describe clearly and to stress the diagnostic, clinical and the surgical aspects of the various problems, giving just so much of the pathological and theoretical information as I deemed essential to a comprehensive working knowledge.

I have omitted from this book the consideration of several lesions such as cleft-palate and hare-lip, trifacial neuralgia, diseases of the salivary and other glands, partly because they are so completely and ably presented in other books, and partly because their treatment requires distinct specialization and they are, therefore, of merely academic interest to the majority of men.

It is impossible to write a book upon any medical topic, at the present time, without consulting the vast literature already published. Still, in so far as this has been possible, I have attempted to avoid compilation. The illustrations, with the exception of two or three, have been carefully

selected from a large collection of original radiographs and photographs to illustrate points of interest. The drawings of the different operations have been executed after photographs made of the operations, and after sketches made by the artist at the operating chair. The operations illustrated have all been tried and have been found to secure satisfactory results in numerous cases throughout the past years.

Complete originality cannot be claimed by the author of any book dealing with medical topics. I gratefully acknowledge the aid which I have derived from the large amount of literature which I have perused for the purpose of information and also to check up my own findings. Although the greatest part of this book is based upon personal experience, gathered from fifteen years of active clinic work and private practice, I cheerfully acknowledge and cede priority regarding any part of the contents to any one who has a just claim for it, although knowledge of this may be foreign to me. But in the final analysis, we must admit that all minds are cast much in the same mould, though they may be variegated in different patterns by innate qualities or external influences; and who can deny that similar experiences, observations and impressions may not produce similar reactions and methods of reasoning in different individuals relative to the same subject?

I gratefully acknowledge my indebtedness to Dr. Rodrigues Ottolengui, whose friendship and approbation have been inspiring through many years of trying effort. I also wish to acknowledge my indebtedness to Dr. Fanuel D. Weisse (now deceased) and to Dr. Henry Sage Dunning, whose early associations in this work formed the early beginnings upon which this book was later based. Dr. Philip Reichert has been kind enough to look up some of the data, for which I am thankful. Nearly all of the photographic work was done for me by Mr. Silas W. Nourse and I am grateful for his many efforts and for the excellence of his results.

Adolph Berger.

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THE PRINCIPLES AND TECHNIQUE OF ORAL SURGERY.

CHAPTER I.

Surgical Technique.

Surgery, as a science in the truer sense of this term, dates from the beginning of the antiseptic period. The discovery of Semmelweis, in 1846, that puerperal fever is due to contamination from the hands, etc.; the discoveries of Pasteur that fermentation and putrefaction are due to the activities of microörganisms, led Lister to the deductions that suppuration may also be caused by similar agencies, and that, if they could be excluded from surgical wounds, the high mortality rate in surgical operations would be greatly reduced. The announcement of Lord Lister, in 1867, that deliberate surgical operations can be performed without being followed by suppuration, marks therefore a new era in all branches of medical practice and separates the surgery of old from what has developed into modern surgery.

The methods and experiments of Lister were rather rudimentary at first and consisted chiefly of spraying the atmosphere with carbolic acid, for it was assumed that the chief source of contamination is the atmospheric air. It was learned later, however, that the microörganisms of the air are, as a rule, not pathogenic, or only mildly so, and not numerous enough to produce disease; that the surgeon's and his assistants' hands, clothing, unclean instruments, linen and other utensils are the true sources of infection.

These discoveries revolutionized our understanding of the causes and the treatment of many pathological conditions. They also paved the way for our present teaching of personal hygiene, sanitation, and our more precise conceptions of cleanliness, for it should be remembered that antisepsis without cleanliness would be useless.

Surgical Cleanliness. Cleanliness is a rather vague and relative term. We must rigorously differentiate therefore between the conception of cleanliness, as applied in our gen-

eral mode of life, in our social intercourse, in the maintenance of health, and what is distinguished by the term "surgical cleanliness."

It seems superfluous to extol the remarkable benefactions that have come to mankind through surgical cleanliness, as this has been so often and so well done by abler writers. We may briefly state, however, that the marvelous and brilliant attainments of modern surgery are, in the largest measure, dependent upon the observation of the laws of surgical cleanliness, or asepsis. Without it, the entire art and science of surgery would crumble to pieces; without its guidance surgery would be much like a rudderless ship, which, through sheer accident, under most favorable conditions, may reach its destination, but is much more likely to be foundered upon some shoals, destroyed upon uncharted rocks, or, after a stormy voyage, reach a strange, unfriendly port.

Surgical cleanliness is the absence of microörganisms and other contaminations. Where this is established it is termed a state of asepsis; the opposite of this is sepsis. Strictly speaking, scientific surgery admits of no degrees of sepsis or asepsis. The laws and the rites of asepsis are unyielding and absolute, for it should always be remembered that every break in the continuity of the epidermis or of the mucous membrane, made by accident or in surgical operations, is an open door for infection.

In surgical operations, all efforts should be directed to secure and maintain surgical cleanliness. That this is not always easily accomplished, is indicated by the fact that the most frequent source of failure in all departments of surgery is sepsis. Though this is a well recognized fact, the error is often committed by surgeons, that, whenever untoward complications of an infective nature arise, they seek the source of failure everywhere but in themselves. No surgeon should think himself immaculate or infallible, and in the presence of failure, he should direct his scrutiny first at himself and extend this to his assistants and his surroundings.

To establish and maintain surgical cleanliness, heat, chemicals, and drugs which possess antiseptic and germicidal properties are used.

Antiseptics. Antiseptics are drugs or chemical agents which are in a mild degree capable of destroying microorganisms and can effectively inhibit their growth and multiplication.

Germicides. Germicides are substances which are capable of destroying microörganisms and their spores.

Sepsis. Sepsis is the presence of microörganisms and other contaminating factors.

Asepsis. Asepsis is a state of complete freedom from microörganisms and the products of their metabolism.

The processes whereby microörganisms and their products are destroyed and removed are disinfection and sterilization.

There are two accepted methods whereby surgical cleanliness or a state of asepsis is attained and maintained in surgical operations—the antiseptic and the aseptic method; for operations in numerous parts of the body, however, both must be combined.

The Antiseptic Method in Surgery.

In the antiseptic method, drugs and chemicals are used to secure and maintain asepsis. The surgeon's hands and the field of operation are treated with antiseptics after they have been thoroughly cleansed; the instruments are sterilized by means of drugs; and the dressings and sponges used are impregnated with germicidal agents.

The use of antiseptics and germicidal agents is open to the grave objection that substances which are potent enough to destroy microörganisms are also destructive of tissue cells. They also cause irritation and excessive exudation and through this they retard cicatrization. They can be used to advantage to eliminate or destroy surface infection and contaminations, but they cannot be used, without detriment, to destroy infections which have deeply penetrated into the tissues. Such deeply disseminated infections can best be controlled by the vital resistance of the host.

Infection.

It may be well here to state that infection is determined by the following factors: (1) the virulence of the invading microörganisms, (2) their number; (3) the vital resistance of the host; (4) the elaboration by the tissues of the host of substances which are inimical to the microörganisms and which can neutralize their toxic products.

It is impossible, physically to remove or chemically destroy all the microörganisms in an infected wound. Because of this and because of the deleterious influence which germicidal agents have upon tissue cells, the general tendency is to depart from the use of drugs in surgical operations. Some surgeons exclude drugs completely from their field of operation or from the wound. This is the aseptic method.

The Aseptic Method in Surgery.

In the aseptic method, after the field of operation has been cleansed and sterilized by means of germicidal agents, this in turn is washed away with sterile water or saline solutions. All instruments and all other substances used in the operation are sterilized by heat or boiling. Briefly, the field of operation and all objects or substances which may come in contact with it are sterile, and during and after the operation the wound is guarded against the entrance of microörganisms. Undoubtedly

some bacteria will find their way into the wound, but as a rule, they are not numerous enough to produce disease, or the few are destroyed by the body defenses.

Drugs Used in Surgical Practice.

Of the more commonly used drugs in surgical practice we may mention the following:

Bichlorid of Mercury. Bichlorid of mercury occurs as heavy colorless crystals or white powder, having an acrid and metallic taste. It is very soluble in water and freely soluble in alcohol. It is marketed in the form of white or blue or green colored tablets, in combination with ammonium chlorid, sodium chlorid or tartaric acids. These ingredients greatly increase its solubility.

Action and Uses. It is a powerful antiseptic and germicide even in a solution of 1-50,000. It is ordinarily used for sterilization of skin surfaces or the hands. Formerly it was extensively used for irrigation of badly infected wounds. Because of its exceedingly irritating properties it should not be used for irrigation nor upon mucous membrane surfaces. In contact with albumen it precipitates a non-soluble albuminate which prevents its deeper penetration. It will readily attack and badly corrode metallic instruments. It is very useful, however, for the disinfection and sterilization of skin surfaces and the surgeon's hands; and for these purposes it may be used in 1-500 to 1-5,000 strength.

Some individuals have an idiosyncracy against bichlorid of mercury. A toxic dose may be absorbed through a mucous membrane surface or from a wound. It may cause dermatitis or give rise to stomatitis, ptyalism, diarrhea, cramps, and even more distressing symptoms. Upon the first toxic signs its use should be discontinued and the symptoms treated.

Phenol. Phenol (carbolic acid) occurs in colorless, needle-shaped crystals, and is obtained from coal tar by fractional distillation; or it may be synthetically prepared.

Action and Uses. Carbolic acid has decided antiseptic and germicidal properties. Because of its escharotic action—unless this is desired—it should never be used in a concentrated form in contact with tissues. In weaker solutions it is readily absorbed and may give rise to toxic symptoms. One of the early toxic signs is that the urine assumes a greenish, smoky hue; other signs are a subnormal temperature, feeble pulse and respiration, muscular weakness and vertigo. It coagulates albumen and when in contact with tissues this prevents its deeper penetration. Being an escharotic, it is also a mild anesthetic, and for this it is

often used to cauterize painful or exposed bone surfaces. Some surgeons use it for the destruction of the epithelial lining of cysts or ranulæ. It is applied with a pledget of cotton and is immediately followed with pure alcohol to neutralize its excessive action. It is used by some for irrigation and disinfection of infected wounds; also in mouth washes, gargles, sprays, and in the form of ointment in 1% strength.

Phenol is readily soluble in water; and in aqueous solution 1-20 to 1-40 strength it may be used for the disinfection, or for the cooling of sterile instruments.

Ziratol. Ziratol, a proprietary preparation, is a brownish, oily, heavy liquid and is very soluble in water. It is a powerful antiseptic and germicide. The manufacturers claim that its germicidal coefficient is much higher than that of phenol. It is only mildly irritating, even in a concentrated form and is practically tasteless and odorless. I find it very useful for the disinfection of rubber inhalers and for the reception of sterile instruments or trays and other utensils.

Alcohol. It has been found that the greatest germicidal power of alcohol is at 70% strength. It may be used alone, or in combination with bichlorid of mercury—1 part of bichlorid to 1,000 parts of alcohol. It is used for the disinfection of skin surfaces and the surgeon's hands; also to neutralize the action of carbolic acid.

Peroxid of Hydrogen. Peroxid of hydrogen is a syrupy liquid and is very soluble in water, alcohol or ether. It is a powerful germicide and kills bacteria because of its oxidizing power. In the oral cavity it is a valuable cleansing agent before operations. It should never be used for purposes of irrigation of abscess or bone cavities as the ebullition of the gases causes intense irritation and pressure, thereby spreading infection. Cryer reported several cases of extensive necrosis of the jaws which resulted from the use of hydrogen peroxid in suppurating cavities. Its use in the oral cavity should be confined to surface disinfection.

Iodin. Iodin is a heavy, bluish black, readily friable solid, having a metallic luster, a distinctive odor and acrid taste. It is volatile and readily soluble in alcohol, but only sparingly soluble in water.

Action and Uses. Despite its irritating properties, iodin is one of the most favored and most extensively used drugs in surgery for surface disinfection. The official preparation of the tincture is 7% strong, and in this strength or in a weaker concentration, it can be used for sterilization of the skin and the oral mucous membrane. It pene-

trates into the deeper layers of the skin and a small quantity is absorbed. In inflammatory conditions it acts as a counter-irritant, probably thereby inducing absorption of the inflammatory exudates. It acts as a direct germicidal agent upon surface bacteria, the more deeply localized organisms being destroyed, probably by the inflammatory reaction which it induces. In milder solutions it is a readily available irrigating substance. For this it should be diluted until of amber color. It acts as a stimulant upon granulation tissues and seems to have beneficial influence upon inflamed, ulcerated, spongy gum tissues.

Iodoform. Iodoform occurs as a fine lemon-yellow powder or crystals, having a peculiar, very penetrating and persistent odor and sweetish, unpleasant, iodin-like taste. It is slightly soluble in water, more soluble in alcohol and very soluble in ether.

Iodoform is a mild local analgesic, antiseptic and stimulant. It is extensively used in surgery for dressing infected and suppurating cavities. When in contact with tissue juices a slight amount of free iodin is liberated and other more soluble compounds are formed. It seems to exert a salutary stimulating influence upon granulation tissues. It may be used as a dusting powder for skin surfaces. Incorporated into gauze, in a 5% strength, it is used for dressing infected wounds and abscess cavities in the oral cavity or about the face. Several odorless iodin compounds have been prepared to take the place of iodoform, but they all appear less active.

Lysol. Lysol is a dark brown oily fluid having a creosote-like odor.

Action and Uses. Lysol is a valuable germicidal agent; it does not corrode metallic instruments and can be used for their sterilization. It is used by some men for the sterilization of the hands, but it is objectionable for either purpose because of its disagreeable and persistent odor.

Boric Acid. Boric acid occurs in colorless transparent scales or as light unctuous fine powder. It is slowly soluble in water, soluble in alcohol and freely soluble in glycerin.

Action and Uses. Boric acid is a mild antiseptic and astringent. In 2% to 4% solution it is used for purposes of irrigation of the oral cavity, infected wounds or abscess cavities. Combined with starch or talcum powder, it can be used as a dusting powder, and in the form of ointment for dressing shallow external wounds. It is also used to saturate external wet dressings in inflammatory conditions about the face.

Potassium Permanganate. Potassium permanganate occurs in slender, dark purple prisms, having a bluish metallic luster by re-

flected light. It is readily soluble in water and decomposes when in contact with alcohol.

Action and Uses. Potassium permanganate is an active oxidizing agent, deodorant, germicide and astringent. It is also an irritant. It is one of the most effective drugs used for surface disinfection of the oral mucous membrane, or for deodorizing and cleansing of the oral cavity. It is particularly useful as a disinfectant and deodorant in the treatment of fractures and foul pathological lesions. For purposes of irrigation it may be used in solutions of 1-500 to 1-5,000. It can also be used for sterilization of the hands in a saturated solution, the discoloration being bleached out with oxalic acid, this being followed with rinsing with sterile water or saline solution.

Dichloramin T. Dichloramin T. contains active chlorin through which it acts as an effective germicide. It is only sparingly soluble in water but it is soluble in chlorinated eucalyptol. It is most conveniently and effectively used, however, in the treatment of infected wounds about the jaws and in the oral cavity, dissolved in chlorinated paraffin (chlorcosin). It may be introduced by means of a syringe or upon gauze saturated with it.

Saline Solution. Physiological saline solution is prepared by dissolving 8.5 grams of sodium chlorid c.p. in 1,000 c.c. of sterile distilled water. A comparatively accurate method for its preparation is dissolving two level teaspoonfuls of sodium chlorid in one quart of water. In the oral cavity this saline solution is used principally as an irrigating medium. It is one of the best for the purpose as it has no injurious influence upon the tissue cells.

The above preparation is not to be recommended, however, for hypodermoclysis or intravenous injection in cases of shock or hemorrhage. For these purposes the more accurate normal saline solution should be prepared. This consists of 5,846 grams of sodium chlorid dissolved in 1,000 c.c. of pure water.

Heat. The most effective and truly reliable sterilizing agent is heat, and this can be used in moist or dry form. Boiling water will, in ten or fifteen minutes, destroy all pathological or pathogenic organisms and their spores. For the sterilization of metallic instruments it is to be preferred to dry heat or superheated steam. For sterilizing of dressings, linen, etc., steam and hot air may be used, preferably in high pressure sterilizers.

Surgical Technique.

It must be apparent that surgical technique comprises more than the performance of the operation alone. It rightly includes all considerations which may have a bearing upon the handling of the case. The surgeon must recognize therefore that his work does not commence nor terminate with the actual performance of the operation.

A surgical procedure, thus more inclusively viewed, may be divided into four stages: (1) the consultation and diagnosis; (2) the preparation for the operation; (3) the operation; and (4) the post-operative treatment.

(Consultation, examination and diagnosis is taken up in the following chapter.)

Preparation for the Operation. That successful surgery is in a large degree dependent upon surgical cleanliness, regardless of the parts of the body involved, or the locality in which it is practiced, is a well established fact. Many untoward complications are inherent to the nature of the case itself; these are beyond the surgeon's control, but complications, arising from sepsis, due to the surgeon's negligence, cannot be condoned.

It is exceedingly difficult, at times, therefore, to reconcile our ideals and our best understanding of what is requisite, with expedience and the practical aspects of a situation. We must recognize, however, that the rigid and uncompromising measures for the maintenance of asepsis, which are inseparable parts of a well conducted hospital operating room, cannot be entirely instituted in office practice. Also, that the laborious preparations which are essential in major operations are impracticable, or well nigh impossible in types of surgery carried on in office practice. This statement is not to be construed as an excuse for a lapse in our vigilance against sepsis. With careful study and application, a system can be devised and adopted which will be simple and yet adequate to meet all requirements.

The Operating Room. Elaborate furnishings in an operating room are more effective in creating psychological influences than for the efficient and expeditious performance of operations. For example, it is very rarely essential to use an operating table in oral surgery, except in major cases, or where, for good reason, ether or chloroform is being used. In these cases, hospital facilities are necessary. Good light is essential. This may be natural or artificial. It is impossible to light up the deeper and more obscure parts of the oral cavity, except with good artificial light. In these cases the author prefers to use the headlight. The floor should be tiled or covered with cement or lino-

leum so that it can be scrubbed and easily kept clean. One should have a good, flexible chair which can be readily adjusted to the various positions indicated; an instrument cabinet, which may be built into the wall or one of a standard make, which may be purchased; a cabinet for linen; a table of some type for holding at the chair the instruments needed in the operation; a sterilizer for instruments; where no separate plant for sterilization of linens is available this should also be in the operating room; a heater for irrigating solutions; an anesthesia apparatus; one or two waste receptacles; a glass table or shelf for the local anesthesia instrumentarium; a wash basin with running hot and cold water having foot or knee action faucets; a surgical engine, for those who use this instrument in their operations, equipped with all facilities for maintaining it surgically clean. Some men find it helpful to have a shadow box near the operating chair for viewing the radiographs during operations. This may be helpful, but it is the author's belief that the radiographs should be thoroughly studied before the operation and the available information should be well fixed in the operator's mind. Through this considerable delay in the operation will be avoided. Pictures, or other decorative, or non-essential furnishings are mere dust collectors and have no place in an operating room.

The Operator's Hands.

The operator prepares his hands by first scrubbing them with tincture of green soap and a sterile hand brush from three to five minutes. It is well recognized now that physical cleansing is more important and efficacious than the application of drugs upon an unclean surface. It is impossible to completely sterilize the hands, as even the pores of the skin, particularly on hairy hands, contain microörganisms. These usually are not pathogenic. With thorough scrubbing their number is reduced and also the greater part of desquamated epithelial cells, which act as carriers of microörganisms, is removed. After thorough scrubbing, the hands are submerged for a few minutes in alcohol 70%, or bichlorid of mercury 1-1,000, and dried upon a sterile towel. The hands having been prepared, nothing but surgically clean objects should be touched or grasped. Adjusting the chair, handling of furniture or the patient must be carefully avoided by the operator. The author and a number of his confreres have found this care of the hands quite adequate for all types of minor oral surgery. Actual digital manipulation of the tissues in oral operations is rarely if ever essential, and the hands must be kept out of the wound, touching this only with the sterile instruments. The above preparation may be modified by scrubbing the hands with a small amount of chlorid of lime and washing soda, dissolved in the palm of the hand; this is

rinsed off and the hands are submerged into alcohol 70% or bichlorid of mercury 1-1,000.

Rubber Gloves. The wearing of rubber gloves is largely optional in minor operations and they should be used only if a sterile pair can be put on for every individual case. Rubber gloves are not essentially sterile and unless they are, they offer poor protection to the

FIG. 1. Enameled trays for holding instruments.

operator and none whatever to the patient. In major operations or where the deeper tissues are being invaded, rubber gloves, rigidly sterilized, should be used.

Sterilization of Rubber Gloves. After use the gloves are thoroughly cleansed with soap and water and submerged in bichlorid of mercury 1-1,000 for ten to fifteen minutes, or boiled for five to ten minutes. They are dried, next powdered with sterile talcum powder and wrapped in linen cases. They are sterilized again in the autoclave, for about twenty minutes, under not more than fifteen pounds pressure.

The Instruments. All metallic instruments should be individually scrubbed and cleansed from all gross contaminations in running water and boiled for fifteen minutes in water containing a small amount of sodium carbonate, about 1%. After this they are dried

upon sterile towels and replaced in the cabinet until they are used again and must be boiled always before using. When removed from the sterilizer, they should be placed in a 2% carbolic acid or ziratol solution for

FIG. 2. Patient swathed in towels, ready for operation.

cooling. This will also prevent their contamination before being used. In the preparation for an operation, only the instruments to be used are placed upon a sterile tray or upon a sterile napkin. Other instruments which are likely to be required are also prepared and conveniently placed

so that they are ready for immediate use. Before proceeding with the operation, the operator himself should ascertain that all the necessary instruments are prepared and laid out in the order in which they are to be used. The sterilization and preparation of the instruments should be done before the patient enters the operating room. The rattling and the sight of instruments is disturbing to many individuals and the unpleasant psychic reactions often complicate the operation.

In operations where only a few instruments are required, the tray method for the maintenance of the instruments at the operating chair is used with a great deal of satisfaction by the author, in his private practice, as well as in clinic work. A number of enameled trays as illustrated in Fig. 1, are always kept sterile and in readiness for use. They may be kept in a sterile basin or submerged in a germicidal solution after they have been sterilized. They should be large enough to hold four or five instruments and shallow, so that the contents are clearly exposed to view.

The Linen. In office surgery the clothing of the patient is not necessarily removed, except such parts as may interfere with the patient's comfort or respiration. The clothes should be covered with a clean or sterile sheet which serves a double purpose. It protects the clothes and prevents them from contaminating the field of operation. Individual sheets or linen capes should be used for the purpose. The repeated use of rubber aprons, favored by some, cannot be approved. The towels used for the protection of the immediate area of operation are sterilized in linen packs, four towels to the pack. A fresh pack is opened for each operation; one of the towels is used to drape the patient's head; one to cover the chin and chest; one to cover the tray holding the instruments and one for the surgeon's hands. (Fig. 2.)

Sponges and Dressings. Sponges and dressings are made of gauze in various sizes, in keeping with the types of operations practiced. Pads may be prepared in suitable sizes for external dressings and for packing off the pharynx during general anesthesia. All sponges and dressings are sterilized in smaller and larger linen or muslin packs and one or more of these are opened according to the needs of the operation. Applicators, swabs, wooden tongue depressors should also be subjected to the same degree of sterilization and kept in dust-proof, closed glass jars or other receptacles.

The Field of Operation. The oral cavity is constantly infested by microorganisms, many of which are pathogenic. Open wounds, such as are created in the ordinary removal of teeth, occurring in other parts of the body, if exposed to similar bacterial contaminations, would be followed by severe infection. This comparative

immunity of the tissues of the oral cavity is not clearly understood at the present time. Investigations have shown that the antiseptic properties of the oral secretions are negligible or practically negative, but that the saliva is a poor culture medium.

We may reason, therefore, that the tissues of the oral cavity are in a measure acclimated to this environment, or that they derive their comparative immunity from the abundant blood supply of this region. It is also suggested that the pathogenicity of bacteria is minimized by the presence of antagonistic saprophites.

The comparative immunity to infection of the tissues of the oral cavity, should be used to advantage rather than abused, as it is but too apparently and too often done. When the deeper layers of tissues, particularly in the sublingual regions, are negligently handled, or when deep injections are made in a septic manner, infections and severe complications often arise. It is impossible to sterilize the oral cavity for even the shortest period. Still, a great deal can be done in the way of comparative disinfection, preceding operations and this should be practiced even though many of our operations consist in the removal of the source of sepsis. In this we must depend more upon mechanical cleansing than upon powerful germicides. The mucous membrane and the gums are thoroughly scrubbed, with a swab saturated with a mild solution of hydrogen peroxid, or potassium permanganate. Where time permits, tartar deposits should be removed and inflammatory conditions, caused by septic irritation, should be corrected. Where the operation is more than the simple removal of teeth; surgical procedures, such as correction of a cleft palate, operation upon the maxillary sinus, removal of growths or the treatment of fractured jaws, these should always be preceded by thorough cleansing of the teeth, the removal of infected, carious and broken down ones, and eradication of all suppurative areas, or other conditions which may be regarded as concentrated forms of infections.

During operation, the direct area of operation is isolated and dried by packing off the salivary secretions with sterile sponges and then painted with tincture of iodin. The iodin is well rubbed into the mucous membrane, especially at points where deep injections are to be made. The principal means of disinfection should consist, however, of the removal of all gross sepsis, as described above.

Preparation of the Patient. In the preparation of the patient we must recognize that his physical as well as his psychological needs must be considered.

The majority of surgeons today recognize that psychic factors play an important part in the preparation of the patient and that these influences

have a decided bearing upon the sustaining of the ordeal of the operation and also upon the recovery.

All profound emotions, particularly fear, grief or pain have a deleterious influence upon individuals. The fear of pain; fear regarding the outcome of the operation; fear of the unknown; all of these are lodged in the primal instinct of conscious living organisms, the instinct of self-preservation. Crile, in his experiments, has proven that profound emotions have a debilitating influence upon individuals, which is analogous to other factors, such as trauma, in producing shock. As in other surgical work, so in oral surgery, therefore, all efforts should be directed towards the elimination of all psychologic influences which may have a deleterious effect upon the patient. The aim should be to minimize, or entirely subdue the agitation and those apprehensions which the prospect of an operation, even though this be a minor one, creates in most people. Numerous measures which lend themselves towards the attainment of this desideratum can be made part of the routine technique.

The following factors may be considered as the most prolific sources for psychological disturbances and untoward complications: (1) the surgeon; (2) fear; (3) pain; (4) trauma; (5) excessive loss of blood; (6) the anesthetic.

Untoward complications arising from these can often be prevented by removing the agencies causing them. The preventive measures may be grouped under the following headings: (1) eliminating the psychological factors by proper management; (2) eliminating pain during operations by means of pre-operative medication and effective anesthesia; (3) skillful operative technique and checking of excessive hemorrhage during operation; (4) the choice and proper administration of the best indicated anesthetic.

The Surgeon. The surgeon must be solicitous about his appearance, his manners and his general attitude towards the patient. He should exercise a degree of tact, instead of blunt indiscretion; a poise of ease, instead of awing and overbearing haughtiness; a kindly, dignified interest, instead of studied indifference. These considerations may be deemed trivial in the estimation of many surgeons, particularly those with whom surgical skill is the acme of importance. The more discerning men, however, recognize to what degree implicit confidence and a tranquil mind conduce to the best of results.

It is also well to bear in mind that a surgical case, of whatever nature, should be viewed from the patient's standpoint, although it may be a very minor one from a surgical standpoint. It is not essential to overstate the gravity of the condition; but, as a rule, patients do not react kindly

when the source of their complaint is regarded lightly or with levity. Also, many easily controllable psychological factors, which often lead to physiological disturbances or even to graver states of shock, could readily be prevented with proper manipulation.

This careful tact should be extended to all members of the surgeon's staff, such as assistants, nurses, or office force; in short, all who may come in contact with the patient in connection with the work, until he is dismissed. Favorable, as well as unfavorable impressions, will be created in any detail of this association. Among other essential points to be observed, we may mention the washing of the hands before the patient is approached for examination; the cleanliness of the linen; the individualness of the drinking glass; the arrangement of the waiting room; the absence of offensive or conspicuous drug odors, etc. Frequent remarks in conversation with patients assure me that, although much of this general detail is closely and critically observed by most discriminating persons, it is often overlooked or neglected by many professional men.

Fear. The emotion of fear is lodged in the primal instinct of self-preservation. Some degree of explanation for this may be found in the psychic phenomenon which must have operated through the ages of conscious human development—the fear of the unknown. Another frequent source of fear is information obtained from others; this may be based upon the informant's or secondarily obtained information of related experiences. With proper management, these forms of fear are often readily dispelled and the patient's confidence gained.

The most troublesome and serious source of fear is personal experience. Fear, so created is, as a rule, more deeply rooted and more difficult to disperse, or to eradicate, than those above mentioned. To be frank, we must admit that the source of this can often be traced to methods of practice—legacies of the past—which, though still adhered to by some, are crude and cruel. We often hear of the removal of teeth, or other similar exquisitely painful operations, being performed without the aid of, or with but inadequate, anesthesia. This barbarous method is often indulged in by some practitioners in the removal of temporary teeth in children at an age when these early terrorizing impressions are carried through life.

Preliminary Medication. Besides proper management as suggested above, we often have to resort to preliminary medication. While this is not recommended as a routine practice, it should be judiciously used wherever the patient's condition demands it. It is to be remembered that the administration of drugs carries a degree

of responsibility with it and that this should be given only with a fairly complete understanding of the patient's condition, the dosage, the physiological and therapeutic action of the drug. A few well selected drugs will prove to be adaptable in the great majority of cases. The object, in the use of drugs, should be to lessen the keenness of susceptibility and the sensibility of the patient, and to aid the action of the anesthetic. Wherever this is possible, it is advisable to limit ourselves to the non-habit-forming drugs.

Preliminary medication is indicated in athletic and alcoholic individuals; drug, particularly morphin, addicts; excessive cigarette smokers; neurotic and hysterical individuals; also to correct, aid or inhibit the function of some of the vital organs and to neutralize the immediate deleterious effect of the anesthetic.

The advantages of preliminary medication are: modifying the action of some of the vital organs; the psychic disturbing factors are diminished; the amount and the concentration of the anesthetic agent may be reduced; the pain following the operation is decreased, rendering sleep and rest possible, which are important factors in the recovery of the patient.

Whenever the surgeon or the anesthetist is hampered in determining the physical condition of the patient, the opinion of the medical diagnostician or that of the physician on the case will prove to be valuable.

The preliminary medication is largely determined by the age, sex, general health, the habits, idiosyncrasy, and psychic state of patient. Other factors to be considered are: the parts to be operated upon, the anesthetic to be used, and the mode of its administration; the nature of the operation, the duration of the operation, and the probable degree of the postoperative pain.

Consideration of Anesthetics.

Technique with Inhalation Anesthetics.

Where ether, chloroform or some other inhalation anesthetic is to be used, which may react upon some of the vital organs and in which the recovery is often prolonged, such cases should not be undertaken in office practice unless equipped with hospital facilities. It is safest to secure hospital facilities and the services of a qualified professional anesthetist in all cases of this nature. All aspects of the case are considered in consultation with the anesthetist in which the preliminary medication, as well as the preparation of the patient, are decided upon.

When nitrous oxid and oxygen is the anesthetic, no preliminary preparation is essential, so far as the regulating of diet or the evacuation of the

bowels are concerned. It is desirable, however, that no solid food be taken for about three hours prior to the administration of the anesthetic. Where prolonged anesthesia is undertaken for oral operations, preliminary medication has distinct advantages. In most cases the nose inhaler is used to best advantage, and in some individuals it is difficult to maintain a smooth anesthesia because of mouth breathing.

Precautions with Local Anesthetics.

In local anesthesia, whatever drug may be employed, preliminary medication may not be essential in the majority of cases. There are, however, numerous instances in which it is almost indispensable.

To secure adequate action of the heart muscles, digitalis may be used, 20 min. every four hours for eight or ten doses. If nausea occurs it should be discontinued at once.

Atropin, 1/60—1/100 gr., may be administered hypodermically twenty minutes before the operation.

Morphin atropin: morphin sulphate 1/6 of a grain, atropin 1/60 grain, is administered hypodermically twenty minutes before the operation.

Codein sulphate 1/8 to 1/4 of a grain administered hypodermically 20 minutes before the operation.

In the use of the above drugs, hypodermic administration is more reliable and the action is more adequate.

Triple bromid, 10 grains, every four hours for three doses before the operation, is satisfactory to allay fear and pain.

Other drugs are favored by different operators or anesthetists, such as morphin scopolamin; proprietary preparations, some of which consist of the coal tar derivatives, bromural, pyramidon, etc., but the writer confines himself to the use of those first mentioned.

Choice of Anesthetics.

The principal criterion in the elimination of pain during operation is, after all, the establishing of surgical anesthesia by the administration of the anesthetic best indicated for the case. With the various methods and drugs for anesthesia at our command, with the varied adaptable facilities for their safe administration, with the numerous men specially qualified in their administration, painful or brutal procedures in operations are inexcusable.

The choice of the anesthetic should never be an arbitrary one. In the choice, the following factors should be held as paramount: (1) safety; (2) efficiency; (3) expedience; (4) the attitude of the patient towards the anesthetic. In these we must be guided by the general health of the patient; the age of the patient; the psychology and habits of the patient; the nature, the location, and the duration of the operation.

Convenience and the patient's desires are the last and least items to be placed in our scale of judgment. Only where there is an equal choice between anesthetics, should these factors be considered, but they must never be permitted to hamper the operation nor to influence the final outcome of the case.

Local Anesthesia. Local anesthesia, whether induced by the infusion or conduction method, lends itself more readily than general anesthesia to the needs of numerous and varied operations about the face and the oral cavity. To those who are accustomed to operate within these regions, the reasons for this are obvious. The following considerations are the more important factors in this connection: (1) the relationship of the oral cavity to the pharynx and larynx; (2) most operations involve bone tissues in which hemostasis is difficult or impossible to maintain and a clear field of operation is essential; (3) a more bloodless field can be secured with a local than with a general anesthetic; (4) the coöperation of the patient is most desirable in these operations; (5) the posture essential in the administration of general anesthetics is often irksome and inconvenient for oral operations; (6) many operations in the realm of oral surgery are of minor nature and even those which might be considered major cases are frequently ambulatory and comparatively rarely require hospitalization; (7) in numerous instances the operation is not in any way formidable and yet, because of the precision essential in its performance, more time is consumed than could be secured with an evanescent inhalation anesthetic such as would be permissible in office practice; (8) considering time as a factor,—and it is an important one in general anesthesia,—the consumption of the anesthetic must continue during the period of operation, whereas anesthesia induced with a given quantity of a local anesthetic will persist in most cases, if the time does not exceed one to two hours; (9) the operation can be carried on more speedily—which is another important factor—as we do not have to contend with the interruptions due to nausea, vomiting, excessive secretions, or respiratory disturbances so commonly met with in prolonged general anesthesia; (10) shock due to the action of the anesthetic, the loss of blood, the deleterious action of the drugs upon some of the vital organs is practically nil as compared with general anesthesia; (11) the recovery of the patient is more rapid and less troublesome; (12) a specialist in anesthesia is not necessary.

There are, at the present time, several potent drugs obtainable, which, as compared with cocain, are of low degree of toxicity. This makes their administration possible by the perinural conduction method in large enough doses to secure complete surgical anesthesia. Much of the pioneer work

in this direction was done by Braun and Fischer. Although Hallstead demonstrated first the injection of the inferior dental nerve, to those two investigators credit is due for adapting the conduction, or block method of anesthesia to the needs of the head, face, jaws, and the teeth. The writer has followed the technique as set forth by Fischer, with a great deal of satisfaction and with very gratifying results through a number of years, in almost all phases of oral surgery in which local anesthesia was indicated. Later authors of text books and contributors to current periodicals have elaborated upon some technical phases of the injections or introduced modifications of merit; these may find ready application in the hands of some operators.

It is not intended here to treat upon the technical phases of local anesthesia as several excellent books have been published upon the subject. But it may be well to point out a few guiding points in the administration of any one anesthetic. Thorough surgical anesthesia depends upon: (1) precision in its injection; (2) the concentration of the anesthetic; (3) the quantity of the anesthetic used; (4) the amount of nerve tissue, i.e. the thickness of the nerve trunk to be anesthetized.

It is desirable with all anesthetics to use the smallest effective quantity, in its least concentrated, potent form of solution. With experience, one must arrive at the conclusion that anesthesia is not always dependent upon the concentration and the quantity of the solution, but more upon accuracy in its administration. This is equally true of general anesthetics. An experienced, well trained anesthetist can maintain surgical anesthesia with the consumption of a comparatively small quantity of the narcotic drug. The writer has often induced anesthesia of the inferior dental nerve with 1 c.c. of a 1% solution of procain, although most of our text books prescribe 2 to 4 c.c. of a 2% solution.

Nitrous Oxid and Oxygen.

The most valuable inhalation anesthetic, in brief oral operations, is nitrous oxid and oxygen. The numerous modern apparatus, furnished with accurate refinements for their administration, make the use of these drugs comparatively simple. Undoubtedly, in many respects, it is a less desirable anesthetic for oral operations than a local anesthetic is. Still, there are many instances and types of conditions where its advantages cannot be supplanted by any other known anesthetic, and in which it is not only ideal but practically indispensable. Because of the exceedingly evanescent anesthetic effect, it is much more difficult to maintain surgical anesthesia with nitrous oxid-oxygen than with any other anesthetic. It is not to be construed, however, that prolonged anesthesia cannot be maintained with this anesthetic. Much of its usefulness is dependent upon the efficiency of

the anesthetist and the possibility of its use is also in a great degree determined by the patient. It is generally regarded as the safest inhalation anesthetic, although now and then fatalities resulting from its administration are reported. Considering how indiscriminately and how carelessly it is often administered, it is surprising that these calamities have not been more frequent. Crile states that nitrous oxid and oxygen, unlike other inhalation anesthetics, does not injure the brain cells and in a measure offers a degree of protection against shock.

Contraindication for Nitrous Oxid-Oxygen.

The use of nitrous oxid-oxygen anesthesia is contraindicated in patients suffering from organic lesions of the heart muscle or valves; high blood pressure and vascular degeneration; asthma; respiratory difficulties; where the air passages are narrowed as in cases of Ludwig's angina; tonsillar, peritonsillar, or pharyngeal abscess; excessively obese patients; alcoholics; excessive users of tobacco, particularly cigarettes, and those addicted to some drugs such as morphin, cocain, etc.

The prolonged administration of nitrous oxid and oxygen may have a detrimental effect upon the hemoglobin of the red blood corpuscles. The chief danger lies, however, not so much in an over dose of the nitrous oxid as in the lack or inadequacy of the oxygen. In the administration of nitrous oxid-oxygen the anesthetist must be much more on the alert than with any other anesthetic. We must not rely upon the percentage of the gases, as indicated by the apparatus for guidance, but the symptoms in the patient must be watched with the utmost vigilance. The color, the rate and quality of respiration, the pupils, the rate and quality of the pulse, especially in prolonged anesthesia, are the indicators of the anesthetic state and the condition of the patient. Maintenance should never be carried on with the patient in a cyanotic state. There always is a degree of duskiness of the lips as well as the face, but the patient should be kept as nearly pink as possible. Once the difficulties in the administration of nitrous oxid-oxygen have been mastered, it is decidedly the most satisfactory general anesthetic from the patient's, as well as from the surgeon's and anesthetist's point of view. It is not unpleasant to take, it is safe and the induction and the recovery are rapid. Even after prolonged anesthesia, the patient is fully conscious and in complete possession of all his faculties, within five or less minutes after the administration has ceased.

Ether or Chloroform.

Ether or chloroform anesthesia is not to be undertaken for adults in office practice, unless the office is equipped with hospital facilities. The administration of these drugs should never be undertaken except with the aid

of a trained anesthetist. In young children, for operations, such as the removal of temporary teeth, cleaning out a necrotic area or the lancing of an abscess, ether is the ideal anesthetic. In young subjects, up to the age of about six, anesthesia is easily induced, little of the anesthetic is consumed and the recovery is comparatively rapid, leaving no untoward complications. Those who wish to avail themselves of the advantages of these anesthetics, as is often essential, should study the subject from every standpoint; the preparation of the patient, the various methods of administration, their indications and contraindications, the symptoms of the different stages of anesthesia and the different signs as to the condition of the patient. Without such a preparation the administration of these anesthetics is somewhat hazardous. Regardless of who the anesthetist may be the burden of responsibility always lies with the surgeon. The tacit understanding between the surgeon and anesthetist as to the sharing of the risks does not clear the surgeon of his responsibility for the anesthetist.

Preparation for and Conduct of an Operation.

Preparatory to an operation, the patient is seated in the operating chair, in a posture to accord with the convenience of the operator and the comfort of the patient. For operations upon the lower jaw the patient should be seated with the trunk in a reclining position and the head thrown forward just sufficiently so that when the mouth is open the lower border of the mandible is practically parallel with the floor. This position permits of better lighting of the parts and makes the field of operation more accessible. For operations upon the upper jaw, the trunk is practically in the same comfortable reclining position, but the head is thrown back so that the palate is almost vertical to the headrest and at an angle of about 90° to the floor.

All dentures which are insecure in the mouth and not fixed to the teeth should be removed, especially if a general anesthetic is to be used. The clothing of the patient is not necessarily removed. When an inhalation anesthetic is to be given, corsets in women, or collars in men which may interfere with respiration should be removed. The clothing of the patient is covered with a linen sheet or cape made for the purpose. Over this the sterile linens may be placed. The patient's head is draped with a sterile towel, but all other sterile linens are placed after anesthesia has been induced, and when the operation is about to be started.

For intra-oral operations the mouth is irrigated with a mild antiseptic solution and all surfaces of the mucous membrane and the teeth are thoroughly scrubbed with a cotton swab. A mild solution of potassium

permanganate, peroxid, saline solution or boric acid, 2% to 4%, may be used for the purpose. The immediate field of operation is painted with tincture of iodin 7% or equal parts of iodin and alcohol.

For extrabuccal operations, if the skin is hairy this should be shaved first. The surface to be operated upon is well scrubbed with tincture of green soap and warm water or an efficient solvent, such as benzin or ether. This is followed with a germicide, such as bichlorid 1-5,000 or alcohol 70%, and dried. When the skin is dry it is painted with a 3% to 4% of tincture of iodin. When iodin is applied to a wet surface it may cause blistering, and moisture prevents its deeper penetration. The patient's head is draped and the field of operation is surrounded with sterile towels. (Fig. 2.) The sterile field should also be covered to protect it from any form of contamination until the operation is begun.

While this is in progress the instruments are being boiled for fifteen or twenty minutes, as stated before. Whenever conditions permit, the instruments should be prepared before the patient enters the operating room, if the sterilization is done in the same room.

The now sterile instruments are placed upon small, sterile, enameled trays as illustrated in Fig. 1. When a larger number are to be used, they are placed upon a larger tray covered with sterile towels. One small extra tray should be handy for discarded or infected instruments, and receptacles are placed upon the floor for contaminated sponges, or other discard. Before proceeding with the operation, the surgeon should see for himself that all instruments which may be needed have been prepared and that they are laid out in the successive order in which they are to be used. By doing this, a great deal of time may be saved that otherwise would be spent in seeking an instrument. With a trained assistant, who follows and understands each step in the operation, this is greatly simplified, as he is always alert in handing the necessary instrument to the operator.

The Operation. In a well conceived operation, all phases and steps in the procedure should be adequately planned. The patient is prepared and no case should be begun until surgical anesthesia has been certainly induced. All the necessary instruments and utensils should have been placed to hand ready for immediate use. Considerable attention should be given to the selection of instruments best adapted for the expeditious performance of the operation and to meet all probable emergencies promptly. With such preparation, the case is approached with greater confidence and the operation can be performed more speedily, more efficiently, with less wear and tear on the vitality and nervous energy of both the patient and the operator, with less loss of

blood and precious time and with a smaller consumption of the anesthetic where inhalation anesthesia is being used.

The surgeon's skill and dexterity is largely augmented by the selection of the most appropriate instrument to perform each phase of the work and considerable attention should be given to their selection. All instruments are designed for the performance of different phases of the operation. While there are many variations in the form and details of design in instruments intended to do the same type of work, still there is a considerable similarity in their general plan. There is a degree of individual leaning in the selection of instruments. While some may be effectively used by one operator, they may be useless in the hands of another. The abuse of instruments lodges rather in faulty manipulation and in their application for kinds of work for which they are not intended. For example, it should be clear that forceps are meant for grasping and the removal of teeth and not for incising soft tissue, nor for bone cutting. There should be no objection to the use of a surgical bur, where extensive cutting of heavy compact bone or tooth structure is necessary, as in the removal of some impacted lower third molars or in root amputation. The objection raised to this instrument, that because of the friction and heat generated, eburnation of the bone, necrosis, and excessive postoperative pain follows, is not borne out in clinical experience. In fact I have more often seen ill results in the way of untoward complications at the site of operation and in the way of psychic trauma, following the excessive and prolonged use of the chisel and mallet. Truly, it is a dangerous instrument when it is septic, or if injudiciously used—but so is every other instrument under similar circumstances. It should always be remembered that in all operations, undue traumatization of tissues and unduly lengthy operations are just as often due to the injudicious selection of instruments as to their faulty manipulation.

Trauma to be Avoided.

Traumatization and rude manipulation of living tissues are opposed to all the principles, precepts and refinements of modern surgery. It should always be remembered that in all operations we are dealing with living, sentient entities,—the tissue cells,—and that their response to treatment and their chances of recovery are in the largest degree, inversely proportionate to the operative trauma. All who aspire to attain the highest degree of success in surgical operations must learn the value of light and delicate manipulation of living tissues and should bear in mind that, at best, aggregate or individual cell life is obtruded upon. Mild temporary interference may be followed by ready recovery; when such interference is severe, prolonged, or repeated, the tissues may recover only with difficulty; they may

undergo degeneration or even necrosis. Bruised, torn tissues are also more prone to infection, because of reduced vital resistance. This principle is equally true regardless of what part of the anatomy may be involved.

Refrain from tearing, laceration, evulsion or undue force. Where the removal of an obnoxious or diseased member becomes essential this should be separated from the healthy tissues, or those to be retained, by means of sharp or blunt dissection. Bone or cartilage should be cut or removed by means of chisels, gouges, burs, and rongeur or bone cutting forceps. The operation having been completed, our attention is directed next to bringing the parts into the most favorable condition for repair and the restoration, as nearly as this is possible, of their anatomical relationship.

Suturing. Wounds following operations in the oral cavity are best closed with interrupted sutures. The severed tissues are approximated and the lips of the wound are brought into apposition where primary union is desired. The sutures should be just tight enough to maintain this relationship until union has taken place. When the sutures are too tight they either cut out, or the inclosed tissues slough, because of strangulation. In clean, non-suppurative wounds, where no subsequent drainage is necessary, complete primary union is permissible. Where irrigation and drainage are necessary, a part of the wound is left open or kept apart by means of dressings.

The intent in the use of sutures is to restore the anatomical, or to maintain an intended relationship of the parts. Catgut, horse hair or silk may be used for the purpose. Catgut is absorbable and subject to infection; therefore it is not the best material for infected surface wounds. Horse hair is more pliable and also, because of its fineness, is very well fitted for the needs of the oral cavity and the face. It can be obtained in sterile tubes, a fresh one being opened for each individual case; or the loose strands may be boiled. Silk twist, black or white, No. 1 or 2, is likewise very well suited for this work where no infection is feared. The coaptated tissues usually unite in five or six days, after which the sutures, having served their purpose, can be removed. In the approximation and coaptation of the divided tissues, care should be taken that the mucous membrane surfaces are not turned in, or that they do not overlap. Mucous membrane surfaces, when approximated, do not unite and when they overlap, the union is delayed, uneven or incomplete.

Postoperative Treatment. The postoperative treatment of surgical cases is often very important so far as the outcome is concerned. In a great number of cases, wounds in the oral cavity heal readily, with no postoperative care what-

ever, despite the ever present microörganisms. The tissues are capable of taking care of a considerable number of these and in clean wounds, where there is no undue laceration, traumatization or cutting off of the blood supply, most wounds heal without suppuration. There are numerous instances, however, where postoperative care is essential: in chronic diseases, such as tuberculosis, diabetes, syphilis, arteriosclerosis, anemia, in which cicatrization is apt to be retarded; in acute abscesses where drainage and irrigation are essential; in large cysts or bone cavities following the removal of deeply impacted teeth; in operations upon the maxillary sinus, etc. Such treatment consists principally of irrigation, dressings, the application of an analgesic to prevent or alleviate pain, or some drug which stimulates granulation.

Wounds upon the face may often be considered aseptic. After the wound has been closed, care should be taken against the entrance of germs, and the parts should be protected from every mechanical injury. In these wounds, where the deeper tissues have been sutured, which will prevent their gaping or opening, the superficial sutures may be removed after two or three days. This will prevent the unsightly cross marks, often observed where sutures are left in longer.

Dressing Wounds. We often hear the expression "packing" a wound. This should never be done, literally, except where distention or pressure is desired. Dressing of wounds in the oral cavity is indicated for the following reasons: (1) to secure drainage; (2) to arrest hemorrhage; (3) to protect the wound from the irritation of substances which may enter the oral cavity; (4) to bring in contact with the surface wound antiseptic, analgesic, or stimulating drugs; (5) to prevent the ingress and the accumulation of food substances and oral secretions in deep-seated cavities, which, if permitted to decompose there, lead to infection.

For purposes of dressing, sterile gauze strips or tape impregnated with a drug, may be used. After having tried sterile gauze, and also some which was impregnated with boric acid, bichlorid of mercury, bismuth paste and 5% of iodoform, the iodoform has been found to be best suited to the needs of the oral cavity. Iodoform is truly objectionable because of its persistent and pungent odor, which may be perceived even at a distance. Any one of the others, however, if left in the mouth, becomes very foul even after four or five hours, and is decidedly more objectionable than iodoform. Iodoform is a deodorant and can be left in a wound for two or three days without becoming foul smelling. It also possesses mild analgesic, antiseptic, and stimulating properties whereby it exerts a most salutary influence upon the granulation tissues.

Drainage. Drainage is of distinct advantage for the removal of lymph, blood or pus. The length of the period during which drainage is to be maintained is to be determined in individual cases. In operations in the oral cavity, drainage is principally indicated in acute abscesses, deep-seated, larger bone cavities, empyema of the maxillary sinus, necrosis and other suppurative conditions, for the removal of pus, lymph or blood, secretions of the oral cavity or other liquids which may find entrance there. Rubber tubes may be used upon the external surfaces, as gauze is not always favorable, where active drainage is necessary. It is well to bear in mind that drainage is based on the principle of physics and not that of chemistry. Gauze, if not properly utilized, is not always favorable for active drainage as the exudates and the pus tend to coagulate upon the wound surface and upon the gauze, thereby damming back the fluid. In the oral cavity, glass or rubber tubes are impractical, and as the interior of the mouth is constantly lubricated with a liberal flow of saliva, no surface coagulation occurs and gauze has distinct advantages.

In large abscess cavities upon the neck, or in the submaxillary region where suppuration is profuse, often gauze alone, or in combination with a rubber tube, may be used for mechanical reasons. If drainage is incomplete, where the incision is not made at the most favorable point for evacuation, the pus has a tendency to burrow into the deeper areas, and secondary incisions become necessary. Where dressing is not carefully carried out so that the entire cavity is loosely lined with the gauze dressing, the walls may collapse and by their uniting, secondary pus cavities may form, and secondary incisions become necessary.

The posture of the patient often facilitates drainage, and in large abscesses or in acute diffused cellulitis upon the face or neck, instruction may be given to the patient to this effect. Care should be exercised that the granulation tissues are not traumatized nor caused to bleed in the removal or introduction of the dressing. In cavities where large areas of denuded bone surfaces exist, the dressing should be left in for at least 48 hours or even three days, for fear that reactionary hemorrhage may be induced.

In irrigation of wounds of the oral cavity, little dependence is to be placed upon the germicidal properties of the irrigating agent. There is no such thing as asepsis in the oral cavity. Mechanical cleansing is of paramount importance. Strong antiseptics are, as a rule, irritating and destructive to tissue cells. Clean, non-infected wounds require no germicidal agents, and in most suppurative cases there is little indication for them after the source of infection has been removed. A normal saline solution is all that may be required in most cases; in infected conditions the writer

confines himself to the use of a mild iodin solution—a light amber color—boric acid from 2% to 4%, or a physiological saline solution.

Irrigation of a wound is generally a simple matter and should not offer difficulties. But it may be in point to state that force should never be used in this process. Have a good size smoothly working syringe. The nozzle of this should never be inserted into the wound in such a manner that the orifice is completely occluded. When this is done the irrigating solution becomes confined and the tension causes considerable pain. The pressure may also injure the granulation tissues and may spread the infection in a pus case. The wound should be simply gently lavaged, until the return is clear.

CHAPTER II.

Examination and Diagnosis.

The examination and diagnosis are just as important factors in the successful handling of a surgical case as the operation. A correct diagnosis is the foundation upon which surgical procedure must be based.

"Diagnosis is the sum total and correlation of the history, the clinical findings and the result of the various specialized methods of examination."

It is to be deplored that, at the present time, in most branches of medical practice, too much reliance is placed upon laboratory tests, radiographs and other specialized forms of examination, often leaving the clinical and individual phases of the case entirely out of consideration. A correct and complete diagnosis must ultimately be based upon the coördination of the clinical findings and all other data by whatever means obtained.

Some specialized methods of examination are quite conclusive so far as the detection of the disease is concerned. For example, a positive Wassermann test is an indication of the presence of syphilis; radiographs will often decidedly determine the presence of a bone lesion or a foreign body. But the detection of a disease or a lesion is only part of a diagnosis. The patient, considered as a whole, and the clinical expression of a lesion or a pathological condition must always play an important part in the treatment of a case. Each and every pertinent factor disclosed should be coördinated.

A reliable diagnosis can be arrived at only by a systematic and accurate examination of the patient. A diagnosis so obtained depends upon keen observation and correct interpretation of all phases of the case.

Nothing develops more the habit of keen and accurate observation and an analytic comprehension in diagnosis, than systematic examination and the detailed writing up of the case. To this end printed blanks should be devised, appropriate for the type of work practiced. The headings should be so arranged that a logical sequence in the examination is carried out and that they act as reminders of the parts to be examined. By filling these out, many errors which might be traced to "snap shot" diagnosis will be

avoided. Besides, by describing the case, often some significant details will be considered which might otherwise be overlooked.

In the examination of the oral cavity and the associated parts, three aspects of the case are to be borne in mind: (1) the local lesion; (2) the presence of constitutional complications and the possibility that these are influenced by the local lesion; and (3) the possibility that the lesion is of constitutional origin and the mode and nature of its local manifestation.

The examination must be complete and wherever this is possible, a definite and accurate diagnosis should be rendered. If laboratory tests, radiographs or other specialized means of examination are indicated, these should be freely and judiciously employed and the patient is advised accordingly. The diagnosis should never be hampered nor influenced by the opinion of others unless such an opinion, coming from a reliable source, is valued. In emergency or acute conditions, many of these details, beyond a close clinical study of the case, may have to be curtailed or entirely dispensed with.

Clinical examination must essentially be based upon a thorough familiarity with the anatomy, the normal appearance of the parts and a clear understanding of their histological structure and normal function. To this end it is desirable to have a well defined mental picture of the normal, so that in our examinations all departures may be compared with this standard. The normal should not be confounded, however, with the imaginary ideal, and allowances must be made for a latitude of variations which may exist under normal conditions in different individuals.

In the clinical study of pathological conditions, note and consider: (1) the subjective symptoms; (2) the alteration in the anatomical outline and relationship; (3) the structural changes in the compromised tissues; (4) the impairment or aberration of function; (5) the involvement of the directly or indirectly associated structures or remote organs; (6) the reaction upon the general health of the individual.

In the coördination of all factors, our diagnosis is distinctly aided by other similar conditions. By recalling these, a more accurate valuation can be placed upon the different signs and symptoms, as well as all other diagnostic disclosures, and we can better estimate the pathological significance of their different combinations. A clear and comprehensive understanding of the different aspects of the case, combined with experience in the treatment of other similar cases and the results obtained, insures a fairly definite outline of the diagnosis, the treatment indicated and the prognosis.

Examination of the Oral Cavity and Associated Parts.

During examination the patient should be seated in a position which renders examination of the parts most convenient. Good natural or artificial light is essential. All the necessary utensils are sterilized and placed conveniently at hand upon a sterile tray, napkin or towel. These ordinarily consist of a cheek retractor, a mouth mirror, a probe, a tongue depressor, thumb forceps and a few sterile gauze sponges. The hands are thoroughly scrubbed before the patient is approached. All intra-oral examinations should be made with appropriate instruments and the fingers should be kept out of the patient's mouth. It is a common failing with some men to put their fingers into a patient's mouth without first determining, or even attempting to determine, whether it is desirable to do so; whether there is an infectious malady present. The hands are nearly always chapped and wherever the epidermis is broken, inoculation and infection are possible. Proper precautions should be observed, regardless of the appearance, the age, the sex, or the station of the individual.

The examination of the patient should commence just as soon as he enters the consultation room. Numerous points of information are often disclosed by a close outer observation of the individual. Attention should be paid to the general appearance of the patient, the facies, the expression, the complexion, the appearance of the skin. Every abnormality which may be present, should be noted and closely studied.

Pain. It is fairly generally believed that pain is a purposeful phenomenon in the scheme of Nature, the intent being to call the attention of the sufferer to the presence of a disease or an injury. Clinical observations, however, often remind us that such assumption, if not entirely erroneous, is at least full of contradictions. For if this assumption were true, it would be logical to assume that the pain would be commensurate with the gravity of the disease or the extent of the injury. In this contemplation we are impressed with the fact that the irritation of an exposed pulp of a tooth, which is so insignificant as far as the welfare and the life of the patient are concerned, causes excruciating pain, while some of the most insidious diseases and their lesions, such as syphilis, tuberculosis, cancer, are practically painless, even in their advanced stages. Whatever our views on the subject may be, and despite the contradictions, the fact remains that pain is always a distress cry of Nature and signifies some form of disturbance or irritation.

The character of pain is often pathognomonic of a certain lesion or disease, and therefore of definite value in surgical diagnosis. Pain in diag-

nosis must be studied and analyzed, taking into consideration the following characteristics.

The Topography of Pain.

The patient should be asked to localize, as nearly as possible, the place or region in which the pain is felt. In neuralgias about the head, such statements are sometimes quite misleading. Pain originating in the teeth, or about the jaws or head, tends to radiate and it is difficult at times to differentiate between the true focus of pain and the reflex pain. For example, pain originating about the teeth often is referred to the ear, or that caused by disease of the maxillary sinus to the occipital regions, etc. In this connection it is well to bear in mind the atypical conditions which may occur.

A knowledge of the mode of onset and the duration of pain is often helpful in determining the nature of morbid processes. Some pains are aggravated in the night time. This may be due to lack of diverting influences or to a greater susceptibility of the patient during this period. Some aches and pains, especially those of a neuralgic origin, are often influenced by the weather, thermal changes, the seasons.

Sudden onset points towards inflammation or neuralgia. Slow pain usually marks slow development which often leads to chronicity. Periodical pains are usually due to temporary or intermittent irritation and are often observed in some constitutional diseases, such as malaria or syphilis.

The qualifications of pain are spoken of as soreness, tenderness, aching, lancinating, burrowing or throbbing; from these characteristics much about the nature and the causes of the pain may be learned.

Soreness upon movement often indicates muscular or ligamentous origin. Aching, darting, or lancinating pain is more often characteristic of nerve involvements. Throbbing pain, which often accompanies inflammatory conditions, is usually due to pressure or distention of tissues, such as is observed in acute abscesses where drainage is inadequate or incomplete. A deep-seated boring pain is characteristic of bone lesions. Pain elicited by light touch of the superficial tissues, indicates affection of the cutaneous nerves. Pain caused by profounder pressure, usually denotes a deep-seated lesion. Pain increased by pressure is due to inflammation; when relieved it is either neuralgic or functional. Inflammatory pains are usually influenced by temperature or position.

The location of pain is often an accurate guide to the point of lesion, provided we recall the nerve distribution, but the possibility of referred pain must always be borne in mind.

The intensity of pain cannot be measured, as it is in the greatest degree subjective and the patient's statement in this respect is exceedingly unreliable: also, it is very much dependent upon the individual's general health,

mental state, susceptibility or temperament. Some individuals are more susceptible to painful sensations than others. Neuropathic patients like to exaggerate the degree of pain and their suffering.

Swellings. Swellings about the face and jaws should be examined and closely observed. The surface appearance is often the source of hasty and erroneous conclusions. The predominance of swellings caused by abscessed teeth in these regions, should not lead to the conclusion that all swellings are caused by abscesses. Though a comparatively small percentage, other and often more serious affections should always be borne in mind when making the examination.

Observe the life history, the location, and the anatomy of the parts in which the swelling occurs; the physical characteristics, whether it is hard or soft, inflamed, painful, tender to the touch. Is it movable or fixed to the surrounding tissues? Is it fluctuating? Does it pit upon pressure? Is the overlying skin movable over it? Note the degree of involvement of the adjacent tissues; the associated lymphatic glands. If there had been any previous treatment, consider the nature of this and the results obtained. In some cases aspiration may prove helpful.

The visual observation of the outer surfaces should be supplemented with gentle palpation of the parts. Digital manipulations should never be made with any degree of force. When excessive pressure is exercised, the examination is painful and the finer sensory perception of the fingers is dulled or entirely lost.

It is good practice to pass the finger tips along the submaxillary area and palpate for enlarged lymphatic glands. Normal glands are, as a rule, not palpable; smaller shotty glands do not always have a pathological significance; enlarged ones should always be regarded as pathological conditions and their causes sought out.

Cervical Lymphadenitis. Lymphadenitis of the cervical glands may be acute or chronic. It may be primary (lymphogenous) or secondary (hematogenous).

Acute secondary lymphadenitis of the cervical glands is much more common in young children than in adults. This is often caused by staphylococcus or streptococcus infection lodged about the teeth, in the jaws, the tonsils, in adenoids, the pharynx, the sinuses, the ears, the scalp, the lips, the face or almost any part of the head. It is not uncommon to observe in young children that cervical adenopathy will come without a demonstrable cause, and pass off without treatment.

The chronic types are more often caused by systemic disease, such as syphilis, tuberculosis, anemia. These may also have some degree of acute

or subacute phase; they may be secondarily involved through metastasis from malignant growths.

In the examination of the cervical region we must first study the local features of an edema and determine whether we are dealing with a glandular swelling. Note the outline and the period of its growth; whether it is painful; fixed or freely movable; the condition of the surrounding tissues and the overlying skin.

If the adenopathy is due to active staphylococcus or streptococcus infection, the gland becomes inflamed, is tender to palpation and may or may not be slightly fixed to the surrounding tissues. If it is fixed to the overlying skin, this presents acute inflammatory symptoms of a variable degree. The gland may become considerably enlarged and fluctuate, indicating a fluid content. Fluctuation is not essentially indicative of the presence of pus unless there is a positive infection present and malignancy is excluded; it may be due to infection even in the presence of a malignant growth. Fluctuation may be due to a breaking down or malignant condition, or an infection superseding malignancy. Many swollen glands subside completely upon the removal of the focus of infection. In numerous cases, however, surgical interference becomes necessary. Periodical increase and decrease in size may nearly always be considered as an inflammatory condition caused by a localized infection.

Tubercular glands are ovoid or roundish in outline, are freely movable in the integument and the skin is freely movable over them. There may be a degree of periadenitis, in which event they are slightly fixed to the adjacent tissues. An individual gland may be affected, but in typical cases the adenopathy spreads until a chain of them becomes involved. A slowly progressive enlargement is observed and those first affected may show signs of breaking down or degeneration. They are painless, as a rule, but may become tender when their enlargement takes on a somewhat rapid course and the surrounding tissues are pressed upon.

Enlarged glands, due to syphilis, are hard and shotty. As a rule they do not form chains or conglomerate masses, and are not painful nor tender upon palpation. They are freely movable in the surrounding tissues, and are often lodged in the posterior triangle. Other factors to be considered are: a probable luetic history, the clinical signs of a chancre, or mucous patches upon the oral mucosa, upon the lips, tonsils, or the face. A positive Wassermann reaction or their yielding to antisyphilitic treatment will determine the diagnosis in doubtful cases.

Enlargement of lymphatic glands caused by malignancy is, as a rule, of a slow and progressive nature. The glands may become painful, the pain being caused rather by the invasion of and attachment to the surrounding

structures, such as the bone, the skin or the muscles. They may become considerably enlarged and soften as a result of breaking down through central necrosis, or a supervening infection. In cases of malignancy many enlarged glands are found to be devoid of cancer cells. At this stage there are also other signs of malignancy. If the site of the malignant growth is not as yet discovered, this must be sought out.

Lymphoma. Lymphoma occurs more often as an individual enlarged gland—sometimes more than one—which chronically grows and becomes stationary. There are no disturbing symptoms, no systemic abnormality, and the blood picture may be normal.

Primary Lymphadenitis. Primary lymphadenitis may occur as the enlargement of an individual gland, but more often a larger number are affected, forming lobulated masses. The condition may be localized at first and may become widely distributed. The cervical glands are most often the first ones to be affected. The condition may be Hodgkin's disease or lymphatic leucemia. There is no apparent etiologic factor, although some authorities believe that a secondary infection may serve as a basis for their development. The blood picture is helpful in differential diagnosis.

Where there are no positive clinical signs or where the clinical signs are obscured, it is part of a proper technique to call in the aid of a proficient pathologist. The advisability of this becomes even more urgent when we consider that besides the diseases to which the glands may succumb in the performance of their function—acting as filters of the afferent lymph—they are subject to malignancy, not only through metastasis but sarcomatous growths may spring also from the lymphoid tissue of the lymph node or from the endothelial cells.

The mandible and the maxillæ should be closely scrutinized. Note: their formation and general outline; their symmetry and the nature of the asymmetry when this exists. In all abnormalities, whether of the bone or of the soft tissues, determine if this is a congenital or an acquired condition.

In bone swellings, or tumors, note: the period of growth; the extent of the displacement of the parts; the nature and the degree of the deformity of the osseous tissues; the degree and the nature of the reaction in the tissues involved; the extent and the nature of the involvement of the soft tissues; the presence of pain and the character of this when present; the condition of the teeth in the region of the lesion; the presence of crepitation or other signs of fracture; the nature and degree of the impaired function.

The most common lesions in these regions are: abscesses, osteitis, osteoperiostitis, osteomyelitis, necrosis, cysts, fractures, impacted and supernumerary teeth with their complications, parotitis and diseases of the other salivary glands; also local manifestations of systemic diseases such as syphilis, tuberculosis, rickets, osteomalacia.

In all lesions about the jaws in which the bone is structurally altered, radiographic examination is indispensable.

The Lips. The vermilion border of the lips is continuous with the oral mucosa and varies in different individuals in size and shape. In a state of health, the lips are bright red in color and they can often be regarded as an index of the patient's general health. They become pale in case of hemorrhage, especially internal hemorrhage, anemia, parenchymatous nephritis, in aortic stenosis, and other vascular disturbances. They may become blue or cyanotic from cold, from asphyxia, an overdose of some of the coal tar sedatives, an overdose of nitrous oxid, in pneumonia and in some types of heart disease, such as valvular stenosis.

In jaundice the lips may be of a yellowish tint; in lead poisoning they may present bluish patches upon their inner surfaces; brownish patches are suggestive of Addison's disease. The lips are also subject to tremor in cases of prolonged debilitating diseases or alcoholism; to deformities and loss of function caused by Bell's palsy, or paralysis of the facial nerve.

Sores or ulcerations upon the lips may be purely local and may be caused by trauma or infection.

Aphthous ulcers appear as small, circular, painful ulcers which tend to coalesce and often break down.

Thrush is more common in young children than in adults, and appears as whitish streaks or patches, causing no ulceration when removed. Microscopic examination shows the presence of Oïdium albicans.

The lips are frequently the site of chancre (primary) or mucous patches (secondary lesions) of syphilis; leucoplakia, angioma, lymphangioma, herpes or fever sores, mucoid cysts, fissures, and epithelioma.

Every persistent ulcer should be suspected as a probable luetic infection or a precancerous condition.

Chronic destructive ulcers, which commence in early life, are slow in their progress and are surrounded by soft nodules, some of which are breaking down, are characteristic of lupus. Other signs of tuberculosis should be sought for.

Syphilitic rhagades appear at the angles of the mouth as chronic fissures, with a thin serumal discharge.

Strumous hypertrophy—chronic thickening of the lips with eversion of the red border and ulceration of the mucosa, is often due to syphilis.

Double lip or hypertrophic changes may also be congenital, or caused by enlargement of the lymphatic vessels.

The lips are also subject to inflammatory diseases and congenital deformities, such as harelip.

The Gingiva. The gingiva, according to Black, is that portion of the oral mucoperiosteum which covers the alveolar ridges, and the gingival portion of the roots and crowns of the teeth. In a state of health, these tissues are of a dense texture and uniformly bright pink in color. The edges are finely scalloped and closely hug the necks of the teeth.

The first evidence of disease in these tissues is probably a break in the gingival ligament. This cannot always be demonstrated clinically. In the more advanced inflammatory stages the gums become discolored, assuming a deep red, or cyanotic hue and become tumefied or spongy, with a tendency to bleed. This alteration in texture is often accompanied by a change in the outline, manifesting as hypertrophy, or atrophy and recession, leaving part of the root of the tooth denuded. The formation of pockets and suppuration (pyorrhea) is an almost constant feature of these somatic changes.

The gums are frequently the site of neoplasms, most of which are benign. Some of these, however, are malignant, semimalignant, or may have tendencies towards malignant degeneration, and must therefore be carefully observed and examined.

The lesions enumerated above most frequently can be traced to some local causative agency. There are diseases of the gingiva in which constitutional conditions play an important part.

In scurvy, the gingiva and the gums become swollen and spongy; they bleed readily, and, if the disease is not checked, the teeth become loose and eventually drop out. In mercurial or in lead poisoning, there is a bluish discoloration of the gingival tissues; they become exceedingly tender and painful; they bleed readily and lose their firmness of texture, becoming tumefied and spongy. Malnutrition, unbalanced diet, tuberculosis, the absorption or elimination of drugs, often result in changes or lesions of the gingiva in which the alveolus and the bone become progressively involved.

In the various kinds of stomatitis, due to parasitic infections, the gingivæ are almost invariably involved. In some of these, such as thrush, aphthous stomatitis, or the milder states of Vincent's angina, they are only temporarily affected. In severer ulcerations, Vincent's angina or trench

mouth, a considerable amount of the soft and osseous tissues are destroyed, so that their original outline is never restored.

The Gums. The gums are continuous with the gingiva and cover the alveolar process and the hard palate. These tissues, like the gingiva, consist of mucoperiosteum and often are invaded by the extension of the lesion from the gingiva. They may also present lesions or signs of disease in which the gingiva is not involved. In their examination, note every irregularity in outline, every discoloration, points of tenderness or the yielding of the bone upon palpation. These always indicate the presence of pathological conditions. Sinuses are often clearly visible; some present as small depressions, others as small elevations or pimples and smaller or larger hypertrophied tissue rings. Still others are discovered only when, upon pressure, pus exudes through them. Sinuses should be carefully probed. The sites of sinuses and discoloration should always be critically examined and radiographed to determine the presence of abscesses, pericementomas, suppurative bone lesions, cysts, etc.

The gums are quite often the site of neoplasms, leucoplakia, tubercular or syphilitic lesions and parasitic infections which may affect the gingiva.

The Teeth. The teeth are the most prolific sources for the formation of pathological conditions in the oral cavity. Morbid conditions about the teeth always manifest as localized lesions at first. The lesion may be lodged in and confined to the tooth substance proper, or the investing and surrounding structures may be affected first and the tooth secondarily involved. It is noteworthy that most dental lesions proper are easily detected in their incipient stages. These could readily be corrected at first, but when neglected they become progressively larger and more difficult to remedy. Diseases of the teeth are rarely self-limiting; through extension, the disease may, in a variable time, successively involve some of the adjacent structures, or spread to remoter areas. Through metastasis, constitutional diseases or diseases of remote organs may develop.

In the examination of the teeth, therefore, not only the obvious and troublesome lesions should be observed, but every predisposing or incipient condition, which may later lead to morbid degeneration, must be carefully noted and, whenever possible, corrected.

In the examination, every tooth which should be present in a normal mouth must be accounted for. Note: their occlusion, the correctness of their position in the arch, their formation; their structure, the development of the enamel, discoloration, the presence of caries, fillings, inlays and other prosthetic restorations. Note their firmness in the jaws, whether they

are tender upon percussion; their response to physical tests, such as heat, cold and electricity; the formation of the surrounding alveolar ridges and other tissues; the condition of the edentulous parts.

Radiographic Examination. No oral examination is complete without a thorough radiographic examination of the teeth. In obscure cases, or where more than purely dental lesions are sought, the jaws and the sinuses must likewise be radiographed. Many pathological conditions or abnormalities may exist about the teeth, the jaws, or within the sinuses, sometimes for a period of years, without causing palpable signs or disturbing symptoms. On the other hand, there are numerous cases in which all the parts are so obviously normal that a radiographic examination is entirely superfluous.

In the routine interpretation of oral or dental radiographs, numerous practitioners have fallen into the error that radiographic examination is the sole and absolute means of diagnosis and that the entire science in this connection devolves upon the differentiation of dark and light areas, or the presence and absence of so-called shadows. The assumption is that the darker areas (in the film) denote infection and the absence of such variation in the film indicates the absence of, or freedom from pathological conditions.

To those who, through a number of years, have been in the habit of identifying these radiographically demonstrable pathological lesions by comparison with the clinical findings, and who have combined this with a close observation of the macroscopic appearance and microscopic examination, it must be evident that where diagnosis is rendered from radiographic interpretation alone, errors are inevitable. The fallacy of such a procedure does not end with the misinterpretation of the radiographs, as this often serves as a basis for therapeutic treatment and also surgical operations.

To be accurate, it is sound policy, therefore, at all times to regard the radiograph as one of the most valuable accessories in diagnosis, but the findings must be compiled from this together with all other available data.

A sound interpretation of radiographs must be based upon: (1) clinical examination; (2) a clear understanding of the anatomy of the parts radiographed; (3) knowledge of the coördinate relationship of the anatomical structures when in a normal state: (4) differentiation of the tissues as denoted by the radiograph; (5) the latitude of radiographic variation which may exist under normal conditions; (6) variations in the radiograph produced by identical lesions; (7) identifying different pathological conditions in which the radiographs are similar; (8) a complete understanding of the pathological condition. From these data and experience derived

from the handling or observation of other similar cases, treatment can be prescribed and the prognosis suggested.

In the study of dental radiographs, the following structures pertaining to the tooth proper may be differentiated: (1) the enamel; (2) the dentin; (3) the pulp chamber and the root canal; (4) the cementum, and (5) the peridental membrane.

The conditions of the teeth and their lesions which may be investigated by means of the radiograph are: the formation, the size and the position of the tooth proper; the number, formation and direction of the roots; obscure carious cavities; secondary caries underneath fillings; pulp nodules; retrograde or senile degeneration of the pulp; secondary dentin; absorption of the root; fracture of the tooth; perforation through the pulpal floor or the root canal wall; foreign bodies in the root canal. Sometimes early stages of caries of the enamel may be discerned. Often the proximity of a filling to the pulp may be judged.

The Cementum. The cementum may present pathological absorption at any point where a pathological condition exists; also hypercementosis, excementosis or cementoma.

The Peridental Membrane. The peridental membrane may present a break in its attachment at the gingival margin. This may be due to traumatic injury; the irritation of a foreign body, such as calcific or serumal deposits; some form of prosthesis or appliance, or it may be caused by septic irritation. There may be a thickening of the peridental membrane in which only part or all of this tissue is involved, which may be due to acute inflammation with the incidental enlargement and swelling of the part; it may be hypertrophy brought about by a milder chronic irritation, by excessive, inadequate, disordered, or lost function. The irritant may be traumatic injury; traumatic occlusion, which may be congenital or acquired through the improper coördination of fillings, inlays or any form of restoration; filling materials pushed through the side or the end of the root; broken instruments projecting into the tissues; chemical, toxic or septic irritants. Other pathological conditions commonly observed are: senile atrophy, pericementoma or dental granuloma; cystic degenerations. Lesions in which the gingiva or the gums are affected often create temporary or permanent impairment of the peridental membrane. The extent of degeneration or destruction of this tissue in pyorrhea can often be judged by means of the radiograph.

The Alveolar Process. The alveolar process may present partial or complete breaking down or pathological alteration. The pathological change may involve only a part which corresponds to a lesion in the soft tissues, or it may extend into the areas

beyond. Here we often observe that similar or identical agencies create varying conditions, or that different agencies may create similar conditions as depicted by the radiograph. It is often observed, where we may justly assume the irritating factor to be infection, that hypertrophic and also atrophic changes may occur.

Atrophic changes are characterized by breaking down of the peridental lamella, indicated by its greater radiolucency in the radiograph, and a variable invasion of the surrounding bone structures. In some cases this is very likely a mere alteration in the histological elements, which may be merely a temporary change in the chemical composition of the histological units of the tissues, which often returns to normal with the removal of the etiological factor. In others, there is a complete breaking down of the bone, which condition is often spoken of as a rarefied or decalcified area. That this last conception is erroneous in chronic cases is proven by the fact that upon exposing these regions, we find that these points are not occupied by decalcified bone, but most often by seemingly organized new tissue proliferations, such as pericementoma and cystic degeneration.

The more common osseous change observed is hyperplasia of the peridental lamella. This is often spoken of as condensation osteitis, sclerosis, hypertrophy. Of the many theories as to the nature of this tissue change, the following two are the more acceptable ones: (1) that there is an increase in the calcium salt content; (2) that there is an increase in the bone lamellæ, that is, a hyperplasia, or an increase in the histological elements which make up the bone. It is reasonable to assume that this osseous alteration is the result of the protective mechanism which is often observed in other regions in inflammatory or suppurative conditions in bone. The fact that upon the removal of the irritating agencies, the bone tends to return to normal, is in favor of this last supposition.

The radiograph is helpful in the study of the nature and the extent of these bone lesions and tissue changes as to whether they are circumscribed or diffuse; whether there is involvement of the adjacent and surrounding structures and the extent thereof.

The radiograph is also of inestimable value in the study of pathological conditions or abnormalities about the jaws and teeth, such as impacted teeth, supernumerary teeth; foreign or misplaced bodies; developmental or acquired abnormalities; periodontoclasia; fractures; necrosis; cysts; salivary calculus; the examination of the sinuses; in the study of neoplasms involving the bone, such as osteoma, odontoma, sarcoma, etc.

The Tongue. Note the formation, the color, the outline of the papillæ. The tongue may become coated as a result of gastro-intestinal derangements or local infection.

Thrush is more common in children and infants than in adults. It appears as milkish white deposits or streaks upon the dorsum or sides of the tongue, which can be readily scraped off without leaving an ulcerated or denuded surface. Microscopic examination shows the presence of Oïdium albicans.

Chancre and mucous patches appear as smaller and larger raised dirty-gray, opalescent ulcers with indurated base. Microscopic examination of the exudates shows the presence of Spirochæta pallida. There may also be submaxillary and cervical adenopathy.

Leucoplakia appears as a whitish, glistening, raised patch, and may be well defined or irregular in outline. The papillæ of the tongue are lacking at the site. In a percentage of cases it was found to have a syphilitic background although irritation is believed to be the direct cause, chiefly excessive use of tobacco. It has a tendency towards malignant degeneration, and when furrows or points of breaking down present, radical surgical measures are indicated.

Papilloma appears as a pinkish projection upon the dorsum or about the edges of the tongue. They are not ulcerating, are not indurated, and may present a constricted or pedunculated base.

Epithelioma of the tongue is believed to be caused by some form of irritation. The most frequent causes are: sharp edges of the teeth, dentures, excessive use of tobacco, etc. Such etiological factors cannot always be traced. Even smaller, innocent looking ulcerations or growths which appear different in color and texture from the tongue, having a somewhat granular surface, and indurated base, should be suspected as being a precancerous or cancerous condition.

Herpes or herpatic ulcers appear as small white blisters upon the tip or about the edges of the tongue. They are painful and when they break down the ulcer presents a punched out appearance.

Traumatic ulcers are due to some form of traumatic injury, such as biting of the tongue, or the irritation of a sharp tooth or denture. These usually present an irregular, ragged appearance, but there are no enlarged glands. With the removal of the irritant, the ulcer heals very readily.

Furrowed fissures and superficial cracks along the edges or upon the dorsum of the tongue, with the intervening tissues in a healthy state, are suggestive of syphilis, especially if they are recurrent.

Gumma of the tongue occurs as an indurated hard mass at first, which may eventually break down. The ulcer so formed presents a dirty-gray sloughing appearance and is not painful, as a rule.

Tuberculosis of the tongue may present circumscribed submucous nodules, which may eventually break down and ulcerate. Tubercular

ulcers may be single or multiple. They are not indurated; they present overlapping edges and a punched-out appearance. It is believed to be caused by infections from the sputum. Other signs of tuberculosis are helpful in making the diagnosis.

Geographical tongue is characterized by crescentic or circular desquamated patches. The patches may be single or multiple and may be localized upon the dorsum or along the edges of the tongue. They may come and go and may be altered in form and size very suddenly. They may display a degree of sensitiveness or burning sensation. The etiology is unknown. Gastro-intestinal disorders and heredity are suggested. Syphilis is not responsible.

Black tongue (*lingua nigræ*). This is not always a constant affection and may come and go with no apparent reason. It appears as brownish or black patches upon the posterior part of the dorsum of the tongue, in the region of the circumvallate papillæ. The etiology is not known. It is believed that the filliform papillæ become hornified and pigmented; others believe that it is congenital in origin; still others believe that it may be caused by a mold and also found in syphilis and diabetes.

Glossitis, acute, may be caused by infection or injury, mercurialism, iodism. The condition is usually painful and is accompanied by fever and other constitutional symptoms.

Macroglossia is a congenital affection, in which half of or the entire tongue is enlarged. The papillæ may also become enlarged. The surface may present elevations which are believed to be caused by enlarged or dilated lymphatics. The tongue may attain such large size that the lower jaw becomes deformed from its pressure.

The tongue may also be the seat of abscess, angioma, benign growths, such as fibroma, papilloma, cysts.

The Floor of the Mouth. The floor of the mouth is frequently the site of pathological conditions. These may originate in the structures of the region or may result as an extension from the adjacent and surrounding areas. Inflammatory, acute lesions are often caused by the spreading of infection from the alveolus or from about the teeth; sepsis, following operations about the teeth or upon the jaws; septic injections of a local anesthetic; excessive operative trauma.

Salivary calculus and obstructions of some of the glands almost always give rise to inflammatory symptoms and subsequent suppuration. Other pathological conditions are cystic degeneration of the submaxillary gland ranula and mucoid cysts. These last conditions are, as a rule, not painful and are rarely inflammatory.

Malignancy is more frequent as an extension from the tongue, the

jaws, the fauces, but may also spring from the tissues constituting or lodged in the floor of the mouth proper, or from the salivary glands. Other lesions found are leucoplakia, angioma, ulcerative and specific lesions.

The Temporo-Mandibular Articulation. Trismus or locked jaw is the partial inability to open the mouth and pain is experienced upon doing so. This should be differentiated from true ankylosis.

Trismus of the jaws may be extra-articular or intra-articular. The extra-articular types, as a rule, are acute and are more common. In most instances they are caused by the extension of inflammation from injuries or diseases of the adjacent or associated tissues and structures. The most frequent etiological causes are acute abscesses of the teeth, particularly lower third molars. Less frequently, similar conditions may arise from the upper teeth and the muscles of mastication may become directly or indirectly involved. Other acute causes are abscesses of the soft palate; tonsillar and peritonsillar abscesses; abscesses caused by septic injections in the mandibular region; parotitis; faulty technique in the practice of conduction anesthesia; postoperative trauma; traumatic injuries caused by external violence; fracture of the ramus or the neck of the condyle.

Intra-articular conditions may develop as a result of extension of inflammation to the structures of the joint proper, or, in rare instances, the extension of the suppurative condition, causing absorption of the articular surfaces. There may be a limited motion of the jaws and pain upon so doing, accompanied by a slight grating, which may be appreciated by the examiner; this is indicative of arthritis.

Reflex trismus may exist as a result of trifacial neuralgia or facial neuralgia caused by diseases or abnormalities about the face and jaws, particularly impacted lower third molars.

Extra-articular, false ankylosis, is characterized by limited motion of the jaws. As a rule there is no acute inflammation causing it, and it is painless. The most frequent causes are cicatrices following deep ulceration due to malignancy, syphilis, scarlet fever, etc., or following injuries and surgical operations. In some instances this may be traced to deformities following early traumatic injuries.

True ankylosis is characterized by complete or a very limited motion of the jaws. The condition is always chronic and can be traced to some early trauma in most instances. The attempt should be made to determine whether the condition is unilateral or bilateral; whether it is intra-articular or extra-articular. In unilateral cases the affected side appears more rounded, while the normal side appears to be flattened. The ramus of

the affected side may also appear to be slightly shorter. The radiograph is very helpful in confirming the diagnosis.

Subluxation of the temporomandibular joint is attended with a distinct crepitus or more often a click. The sound produced can sometimes be heard even at a distance, and movement of the joint may or may not be painful. The condition is often observed to follow excessively forceful opening of the mouth in yawning or after lengthy dental operations. The condition may become corrected of its own accord, or it may remain permanently.

If, in the absence of localized symptoms, or operative history, the muscles closing the jaws become rigid, and there are severe painful spasms which extend to the muscles of the trunk, tetanus should be suspected.

Dislocation of the jaws is almost always forward and bilateral. It is characterized by inability to close the mouth, and its staying ajar.

Offensive Breath.

Offensive breath is most frequently due to localized conditions or diseases lodged in the oral cavity. The most frequent causes are: carious teeth, poorly executed restorations in the way of fillings or artificial crowns, ill-fitting dentures, particularly bridgework of the fixed type, which permits of no cleansing; the decomposition of food particles wedged into carious teeth, into the interdental spaces, or adhering to prosthetic restorations. Other local causes are suppurative conditions in the way of chronic abscesses or infected cysts, communicating with the oral cavity; periodontoclasia; the various forms of stomatitis; necrosis of the jaws; diseases of the tonsils; adenoids, syphilitic gumma; empyema or malignancy of the maxillary sinus; malignancy of any of the tissues of the oral cavity, of the pharynx, of the larynx; indigestion and gastric disturbances; stomach ulcer and malignancy of the stomach; diseases of the liver; abscessed conditions of the lungs.

A sweetish breath is observed in individuals suffering from diabetes; a urinous odor in uremia; in diphtheria and in most of the febrile diseases the breath has a peculiar and often characteristic odor.

In the further examination of the oral cavity, our attention should be extended to the parietes, the hard and soft palate, the tonsils, the pharynx, and all other associated structures. A partial examination and a diagnosis based thereon is often less helpful to the patient than no examination. We should be guarded in expressing an opinion in reference to structures with which we are not thoroughly familiar, but dealing with those structures or parts in which unqualified reliance is placed upon our examination our diagnosis must be complete from every standpoint. In obscure cases our findings should be coördinated with those of other specialists. Examination of the teeth proper should be supple-

mented with the investigation of all related structures, and the pneumatic cavities of the head, by means of radiographs and transillumination. Numerous pathological lesions, though widely different in character, present symptoms and signs which are similar in their clinical manifestations. The differential diagnosis is most vividly aided by detailed and close study of individual cases.

Complete records should be kept of every case that may come under our care. Well kept records tend to broaden our knowledge by making it so much more possible to understand the progressive stages of a disease. They are also of great value as a matter of reference.

CHAPTER III.

Hemorrhage.

Hemorrhage is the escape of blood from its proper channels. This may arise from wounds of the arteries, veins, or capillaries.

The causes of hemorrhage are: direct injury caused by accidental trauma; surgical operations; irritation of foreign bodies or loose fragments of bone; pressure, followed by necrosis of the soft tissues; sepsis and the spreading of infection; invasion of malignant growths.

Hemorrhage following minor operations upon the structures of the oral cavity proper is rarely troublesome in the largest proportion of the normal run of cases. In operations upon the deeper portions of the mandible or the maxilla, upon the tongue, the sublingual structures, the maxillary sinus, upon the soft palate, or upon the lips, hemorrhage may be considerable. In some instances even the removal of a tooth is followed by hemorrhage which is difficult to control, and the untoward complications are much more severe than such minor operations would warrant.

The cases which are prone to give rise to complications of hemorrhagic nature may be stated to be of three classes: (1) those cases in which the soft or osseous parts bleed as a result of the surgical trauma; (2) patients who are suffering from constitutional dyscrasia which prevents the normal coagulation of the blood; (3) hemophiliacs or congenital bleeders.

It may be stated that hemorrhage in operations performed anterior to the bicuspid teeth is less likely to be excessive than in those performed posterior to these teeth. Following up the reports of the recent war * it was found that even in extensive, disastrous oral and facial mutilations, such as we but rarely encounter in civil practice, a comparatively small percentage of cases was complicated with severe hemorrhage. Some of these were controlled only after the ligation of the external carotid artery, and a small number, despite all controlling efforts, terminated fatally.

Taking the normal individual as our standard, there are three elements to consider in the prognosis of a case: (1) the amount of blood lost; (2) the rate of loss; and (3) the blood pressure.

* Kazanjan, Valadir.

Effects of Hemorrhages.

Henderson, in a series of experiments upon 53 dogs, found that if the animal was bled 0.25% of its body weight every five minutes for one or two hours, until the blood pressure had fallen to about 28 mm. and the animal was left alone, the chances of recovery or death were about equal. Those that were bled to even a slightly less degree survived. All of those which were bled at this rate, or even a slightly greater degree, died within two or three hours, or even less time, after the termination of the hemorrhage.*

The results of these experiments are not to be regarded as definite standards to be guided by, however, as there are numerous other conditions which must enter into our considerations in this connection. Some surgeons believe that in strong, healthy adults the loss of half of the total amount of blood is certain to be fatal. In some young children, even a slight loss of blood may be fatal. Old, fat, weak, anemic individuals, or those suffering from debilitating diseases, are very susceptible to the loss of blood, and the more rapidly the hemorrhage takes place the more dangerous it is.

Causes of Death Following Hemorrhage.

The theories regarding the direct cause of depression and death following severe hemorrhage vary. From an extensive series of experiments, Crile concludes that: "It may be assumed that the primary factor is anemia with a consequent lessening of the immediate nutrition of the active physiological mechanism for the maintenance of the normal blood pressure." ** Among the secondary factors Crile places the failure of the vasomotor center first. Henderson and Mann hold the view that, as the peripheral reservoirs are depleted, the venous return to the right auricle of the heart is reduced and finally becomes inadequate.*** As the left ventricle of the heart can discharge into the arteries only the amount of blood which flows into the right auricle from the veins, the weakened pulse, the decreased blood stream, the lowered blood pressure are the resulting consequences.

The treatment and untoward results in severe cases of hemorrhage seem to indicate, however, that the mechanical failing of the circulation in itself does not explain all of the phenomena which occur. Thus, it has been found that the infusion of saline solution, intended to overcome this particular defect, gives only temporary relief, and it soon passes from the blood vessels into the tissues. Bailiss and his collaborators attempted to overcome this tendency by modifying the saline solution with gum acacia.

* Henderson and Haggard, *Journ. A. M. A.*, Mar., 1921.

** Crile, *Surgical Shock.*

*** Henderson and Mann, *Journ. A. M. A.*, Mar. 11, 1922.

The properties of this solution more closely resemble that of the plasma of the blood; nevertheless it was found to be equally inadequate. Blood transfusion alone has given lasting and satisfactory results. This strongly suggests, therefore, that besides the mechanics of circulation, the chemical and vitalizing properties of the circulating fluid are of paramount importance in the maintenance of life.

Henderson * believes that a sufficient rôle has not been ascribed to the loss of the red blood corpuscles and that the effects of hemorrhage must be considered not only from the standpoint of circulation but also from that of respiration and energetics. Hemorrhage, according to this investigator, produces a condition which may be regarded as a form of air-hunger—a symptom of asphyxia. Acidosis, or the concentration of the H-ion, is created as a result of inadequate oxidation, through the breaking down of the carbonic acid and sodium bicarbonate balance which normally exists in the animal body.

Hemorrhage may be: (1) primary; (2) reactionary; and (3) secondary.

Primary hemorrhage begins with the operation and continues after this has terminated. In normal individuals, when operating upon the jaws proper, this occurs but very rarely, unless a large blood vessel is severed or injured, such as the posterior palatine, the inferior dental, the facial, or the coronary artery in operating about or upon the lips. Yet, in rare cases, even the removal of a tooth is followed by a persistent, uncontrollable hemorrhage, so that the patient's health or life may become endangered and even fatal terminations have been recorded.

Reactionary or delayed hemorrhages are just as irksome as they are troublesome. Where the patient's history or some existing dyscrasia indicates, proper precautions must be taken to prevent it. In the oral cavity this is more likely to follow operations under local than under general anesthetics, when immediate steps may be taken to control a bleeding surface or vessel. The suprarenin content of the local anesthetic, on the other hand, acts as a temporary hemostatic and with the wearing off of this effect, hemorrhage may occur.

When a patient is in the hospital, a capillary hemorrhage is not, as a rule, of immediate or grave concern, as the rate of flow is usually slow and is easily controlled. Most of these patients, however, are ambulatory cases and their homes may be at a distant or inaccessible place or out of town. It is judicious precaution to permit no patient to leave the office until the hemorrhage is absolutely under control.

Secondary hemorrhages occur as a result of insecurely ligating a

* Henderson and Mann, *Journ. A. M. A.*, Mar. 11, 1922.

severed vessel, undue lacerations of the soft tissues, comminution of the bone and mangling of the structures operated upon; sepsis; sloughing of the tissues resulting from undue trauma; the action of a toxic drug or toxic dose or toxic concentration of a less toxic drug used as a local anesthetic. It may also occur following operations in which large areas of bone become denuded or exposed, as in large cyst cavities or operations upon the maxillary sinus; in operations upon the hard or soft palate or in the sublingual areas.

Treatment of Hemorrhage. The treatment of hemorrhage may be divided into five phases: (1) prevention; (2) immediate treatment; (3) the prevention of recurrence; (4) operative treatment; (5) the recovery of the patient.

Hemostatic agents comprise: (1) ligatures and sutures; (2) torsion; (3) acupressure; (4) pressure and compression; (5) the use of drugs in the way of styptics, or hemostatics which may be applied locally or those which may be administered hypodermatically, intravenously or by ingestion.

In the treatment of hemorrhage we must recognize first the point where the blood issues from. When this is obscure, palpation of the soft parts or digital pressure upon the vessel, distal to the bleeding point, will stop the hemorrhage if this is lodged in the soft tissues or between the overlying soft tissues and the bone. If the rate of flow cannot be influenced with digital manipulation we may conclude that the hemorrhage very likely comes from the bone or a vessel which has not been reached.

In operating upon the face, jaws, or upon any tissues of the oral cavity, we should consider: (1) the tissues which are attached to or associated with the bones, such as muscles, fascia, integument, etc.; (2) the mucoperiosteum which is closely stretched over the bone and (3) the osseous tissues. These parts and their vascular supply must be clearly understood, as the treatment of the hemorrhage is in a large degree determined by: (1) the degree and nature of the hemorrhage; (2) the location; and (3) the type of tissue in which the hemorrhage occurs.

The most frequent and troublesome source of hemorrhage in operations in the oral cavity is capillary ooze from both the hard and soft tissues. This, in many instances, is very persistent and profuse and entirely out of proportion to the extent of the operation or the injury, and may occur as a primary, reactionary, or secondary hemorrhage.

Compression of the tissues and direct persistent pressure upon the bleeding surface, in most instances, will control the hemorrhage, even in cases of hemophilia or in the presence of other constitutional dyscrasia in

which the coagulation of the blood is delayed. The method of doing this could perhaps be best illustrated by the citation of a case in point.

Case History. The patient was a male, white, 23 years of age. Medical examination disclosed no functional nor organic abnormality. He gave a history of persistent hemorrhage from severe injuries or cuts. He had had his upper right bicuspids and first molar removed, under nitrous oxid-oxygen anesthesia, four days before I saw him. There was a moderate amount of bleeding for the first six hours and thereafter it stopped, though not completely, for about eight hours. After this the bleeding became quite profuse and a physician, who was present at the extraction, was called to the aid of the dentist on the case. The bleeding continued for three nights and three days, with slight temporary remissions, when the writer was invited in for consultation. The patient was found lying in bed. He was dull and listless and seemed considerably exhausted. He was extremely pale, his eyes were dull and expressionless, his skin cold and clammy, the pulse rapid and of poor quality, and respiration slightly labored. The temperature was slightly below normal, 97° F. The physician stated that he had been trying to supply all the nourishment the patient would retain. Saline hypodermoclysis had been given several times and considerable quantities of thromboplastin were hypodermatically administered; the latter was also locally applied, with only slight periodical, incomplete stoppage of the flow for brief periods.

Upon examination, I found the tooth sockets quite open, with a wad of absorbent cotton thrust in, with the larger part projecting outside the lips of the wound. This was saturated with blood clot, mixed with saliva and food, and was rather dirty and foul smelling. I explained that I would try to control the hemorrhage with local treatment, and if this failed in three to five hours, owing to the rather bad state of the patient, it would be advisable to transfer him to a hospital, that blood transfusion might be performed. The wad of cotton was removed, and with palpation it was ascertained that the largest degree of bleeding came from the palatal aspect. Pressure was exerted upon this point with a sterile sponge, held with a pair of thumb forceps, while the wound was cleaned of all foreign substances with a quite warm solution of peroxid of hydrogen. Peroxid of hydrogen, applied in this manner, has some degree of hemostatic properties. The clot occupying the deeper portion of the wound was not disturbed. The jagged edges of the bone were trimmed away next with a pair of rongeur forceps, just sufficiently to prevent them from lacerating the overlying gums. A piece of iodoform gauze was saturated with adrenalin chlorid and packed firmly into the wound and the gums were

pressed firmly over this; the tissues were compressed next with a gauze sponge: all this while the assistant, with a gauze pad and finger pressure, held down firmly the anterior palatine artery. During this time a piece of modeling composition was softened and molded next over the area, bringing this up considerably both on the palatine and buccal surfaces. The patient was asked to bite upon this, without completely closing the teeth; the compound was slightly chilled and the patient asked to bite down a little more, without, however, completely closing the teeth. While doing this, the compound was firmly pressed down with the fingers on the buccal side and the patient did the same with his tongue on the palatal side. Now the compound was chilled completely and the patient requested to bite down firmly. To secure constant pressure and to aid the strain upon the muscles, a Barton bandage was put on. The patient was fed through a glass tube with liquid food, such as eggnog, milk, broth, etc. After staying at the bedside for two hours, no bleeding whatever was noted. After twenty-four hours there was scarcely a trace of blood in the saliva. The compound was gently lifted off. The iodoform gauze packing within the wound was not disturbed at all, but the outer gauze layer was replaced with a fresh one, saturated with adrenalin chlorid. The compound was replaced and the biting pressure secured again with a bandage. This maneuver was repeated for three days and on the fourth, the inner iodoform pack was loosened with a warm peroxid solution and removed without inducing hemorrhage. The compression of the tissues was continued for an entire week, when healing was fairly well under way.

The error that a number of men make is that they thrust a portion of cotton, saturated with a styptic, into the wound, which, thanks to the temporary action of the medicament, seems to abate the hemorrhage. With the passing off of this, the swelling cotton wad tends to spread the tissues and practically acts as a wick. In the method above described, direct pressure and also compression is exercised. Ligating of the anterior palatine artery did not seem advisable in this case, for fear that hemorrhage at the stitches might further complicate the case.

Treatment of Severed Blood Vessels.

When operating upon a clearly exposed bone surface, a severed vessel is indicated as a spurting jet or pulsating welling up of the blood. A severed vessel lodged in the bone substance can often be stopped by a rotary crushing force, applied over the bleeding point with a blunt instrument, such as a curette. In many instances a spurting vessel will stop with no interference whatever, because of its retraction, the formation of a blood clot and the pressure of the unyielding walls of the channel in which it lodges. This often occurs even in instances where

larger vessels are severed, as it is often observed in complete fractures of the mandible. The structures contained in the mandibular canal are completely torn and yet complications from hemorrhage are very rare. In the removal of larger cysts or other pathological conditions in which the inferior dental canal is involved, it is good practice to clear the posterior parts first and stop off the canal by means of gauze packing which may be saturated with adrenalin chlorid. This will greatly decrease the loss of blood and will also secure a clearer field of operation.

Capillary Ooze. Capillary ooze from bone tissue during operation can best be controlled by pressure. The ooze may be confined to some parts only, or the entire exposed surface may bleed. Pressure may be exerted by means of sponges held down for a few minutes until the area is cleared and the operation may be proceeded with. Where the operation is a prolonged one, sterile hot water may be applied upon sponges. The water is kept handy in an enamel basin. The same method may be applied to control hemorrhage of the gums and other soft tissues where the hemorrhage is not very profuse.

Bleeding Vessels in Soft Tissues. When operating upon the soft tissues of the oral cavity, upon the lips or the face, or when large portions of the gums are detached from the bone during operation, bleeding vessels are best secured with catgut ligatures. Because of inaccessibility of some of the parts, or because of the retraction of the severed vessel, acupressure is often more expedient. This consists in first determining the point where the vessel lodges and by passing a ligature about the tissues containing it the compression of the tissues will stop the hemorrhage. This method often has been successfully employed in instances where the branches of the anterior palatine artery have become severed through too extensive lacerations in the removal of upper molars. A needle, conforming to the curvature of the palate, is passed between the mucoperiosteum and the bone and the constriction of the silk or catgut ligature will arrest the hemorrhage.

Treatment of Root Sockets After Extraction. In the removal of teeth, the tooth socket becomes filled with a blood clot which acts as a tampon and also protects the deeper parts of the wound from infection by the ever present microörganisms. It is good policy to thoroughly compress the tissues, as in many instances the alveolus is essentially spread, split or fractured in the removal of the tooth. By compressing this, the wound is decreased and therefore the healing will be more prompt, the jagged outline of the wound is in a great degree corrected and this will also aid hemostasis. The wound should always be closely inspected and loose portions of the alveolus removed;

frayed or torn portions of the soft tissues should be trimmed away. In many instances, where the bleeding is likely to be troublesome, cold or hot water irrigation, as cold or as hot as the patient can bear, will aid in inducing hemostasis. Where the bleeding does not seem to stop with these measures, it is a good plan to pack the cavity with iodoform gauze, saturated with adrenalin chlorid, 1-1,000. Place a gauze plug over the wound and let the patient firmly bite upon this. The patient is kept in the office for about ten or fifteen minutes, when it will be found that the bleeding ceases in most instances. Particular precautions should be taken, however, in patients who are suffering from hemophilia, leucemia, purpura, anemia or some other dyscrasia in which the coagulation of the blood may be delayed.

Hemophilia.

Hemophiliacs, or congenital bleeders, are individuals in whom the coagulation of the blood is prevented or unduly retarded because of some inherent, probably chemical, deficiency of the blood constituents.

Nasse, who was one of the first investigators of this affliction, formulated the law that the malady is limited to the male and is transmitted through the unaffected female offspring to the male progeny.

Causes of Hemophilia.

Morawitz and Lessen state that the delay in coagulation is due to a deficiency of fibrin ferment factors, especially thrombokinase. Duke believed that uncontrollable hemorrhage is due to insufficient blood platelets and advised blood transfusion. Still others believe that there is a lack of calcium which plays an important part in the coagulation of blood, and the inability of some individuals to assimilate the calcium content from the food taken. (Kahn.) Wright held that lack of calcium salts in the blood is the cause.

Symptoms of Hemophilia.

Very often the surgeon has to operate upon a patient without knowing that he is suffering from a constitutional malady which makes hemostasis difficult. It should be remembered therefore that evidences of this affliction are noted in early infancy. The most common characteristic is severe hemorrhage from injuries or bruises which would scarcely bleed in normal individuals. Epistaxis and swelling of the joints is common among bleeders and they usually give a history that small cuts or minor operations, such as the removal of a tooth, have been followed by severe uncontrollable hemorrhage. A single instance of hemorrhage, however severe, does not necessarily determine hemophilia.

In doubtful cases, it is good practice to test the blood of the individual. The blood specimen is best taken from a vein by means of a hollow needle,

as the capillary blood taken from the skin, with its admixture of tissue juice, may fail to show the characteristic delay in coagulation. Normal blood, drawn in a clean test tube, usually clots in twenty to forty minutes, at room temperature.

To test the coagulability of the blood, Duke's modification of Williams's method is most acceptable for office practice. A microscopic glass slide is mounted with two small glass disks, five millimeters in diameter. Drops of blood, large enough to cover the disks, are taken and the slide in inverted over a glass of warm water, 38° C. After the coagulation has proceeded to a degree the form of the drops will not change if the slide is held in a vertical position. Normal blood, under these circumstances, clots in six to nine minutes.

Treatment. Hemostatic agents or styptics applied locally are of little real value in hemophilia. Their use may be helpful as a temporary measure or in combination with other means. The application of adrenalin chlorid is very valuable but is often followed by even more severe reaction unless it is combined with pressure and compression. Searing the bleeding surface with a hot (not glowing) steel cautery may prove effective in giving temporary relief. The local application of serum or thrombokinase is often valuable, but the attempt should be made to force these into the bleeding tissues by gentle massaging. Sayer * reported cases in which he succeeded in stopping severe hemorrhage by applying his own blood to the bleeding tissues. Other cases have also been reported where persistent hemorrhage was arrested by this means. This rather suggests that the agents essential to the coagulation of the blood can be absorbed in this way.

Fresh human serum has long been considered as the most effective agent for controlling all kinds of severe hemorrhage. Fresh sera from lower animals, such as the ox, sheep, horse, goat, have also been found to be very valuable. The dosage depends upon the individual case. Usually 100 c.c. is given subcutaneously the first day, the dose being diminished from day to day. Intravenously a smaller quantity is sufficient, as no part is absorbed by the tissues. Baum considers that serum is indicated in all cases of hemorrhage except true hemophilia. In securing the serum the donor must be healthy. Wassermann reaction should be made. A hollow needle, the size used for a Wassermann reaction, is plunged into the median basilic vein and the blood is collected in a flask. The flask is placed in a slanting position and left there for six hours. After this the serum will have separated and is ready for use.

As a preventive measure in cases of hemophilia, blood transfusion was

* *Journal A. M. A.*, Jan. 13, 1912.

used by Meyer in jaundice. Human serum may be administered subcutaneously, 30 c.c. three times a day the first day and 30 c.c. each day for three days before the operation. This dosage may be decreased when administered intravenously. Calcium lactate or calcium chlorid, 30 to 35 grains in 5 to 7 grain doses, may be taken by ingestion during the twenty-four hours before the operation. This, combined with thorough packing off of the wound or other local measures for hemostasis, has been successfully used in numerous cases by the writer.

CHAPTER IV.

Inflammation.

A change in the environmental conditions vital to an organism constitutes a stimulus, and calls forth a characteristic reaction. If a stimulus is below the threshold of irritability of the protoplasm of the cell, the characteristic reaction does not occur; if the stimulus is within what might be termed the normal range, the response is functional. If the change is excessive, the stimulus becomes an *irritant* and may have a deleterious effect upon the tissues of the organism, and the reaction that takes place becomes an *inflammatory reaction.*

The irritant may be a *mechanical* injury; it may be extremes of *temperature,* the effect of *radiant energy* as from the Roentgen ray, chemical substances, electricity and sepsis or bacteria. Bacteria may act as mechanical irritants or may produce substances which cause chemical irritation. These agents rarely act singly. Traumatic injuries are nearly always accompanied, or succeeded by bacterial invasion, and a combination of any of the others may coexist.

The severity and course of the inflammation depends upon (1) the kind of irritant; (2) its intensity; (3) the extent of tissue subjected to it; and (4) the length of time that the irritating action is in force. Time is relatively more telling than the intensity of an irritant, and a comparatively slight irritation, continued through a longer period of time, will give rise to a disproportionately intense inflammatory reaction. This is true of all types of stimuli, and what may be a slight stimulus at first becomes a severe irritant if prolonged or repeated.

In bacterial invasion, besides these, a number of other elements which control the nature and intensity of the reaction must be considered. These are the number and virulence of the microörganisms antagonized by the vital resistance of the host, and the elaboration of substances which are inimical to bacterial growth and capable of neutralizing their toxic products.

The phenomena of an inflammatory reaction are more conveniently

explained by their arbitrary division into a number of stages. It must be remembered, however, that no definite lines of demarcation exist and that the process is a continuous one; that throughout almost its entire duration all of the phenomena may be present in the whole or in different parts of the same lesion.

Hyperemia. The first stage of inflammation is marked by hyperemia. Hyperemia is an intravascular change in which an increased amount of blood is present in the vessels of a part. Ordinarily it may be produced in two ways. If there is an obstruction to the venous drainage of a capillary system we have a passive congestion in the affected part—so-called *passive* hyperemia. If the venous drainage is not affected, but there is an increased arterial supply to the part, this also causes congestion; but in this case it is termed *active* hyperemia. Hyperemia which occurs in an acute inflammatory process is of the latter or active type. The phenomena can be demonstrated by experimental irritation of membranes under the microscope. In these experiments the mesentery of a frog or the wing of a bat is commonly used; in these tissues the capillaries, the arterioles, and the circulation of the blood are plainly seen, and when an irritant is applied, the entire course of the reaction may be directly observed.

At first there occurs a slight and rapidly disappearing constriction of the arterioles, which is succeeded immediately by a relaxation of these vessels. The increased blood supply causes enlargement of the capillaries, and this is the active hyperemia of inflammation. In a variable time the observer will note that an adhesive quality appears to develop between the white blood corpuscles and the capillary wall. Occasional cells cling to the wall for a moment and then are swept along with the blood current. This adhesive quality becomes more and more marked; the occasional cells become more numerous and remain adherent, until the dilated capillary wall is covered with so thick a layer of white blood cells that the rapidity of the blood stream is retarded. The next phenomenon leads to the assumption that another change has taken place in the vessel wall—an increase in its permeability, which permits the passage of the white blood cells into the surrounding tissue spaces. The process of these ameboid cells leaving the capillary is called migration of the leucocytes. In this manner great numbers of leucocytes infiltrate the tissues of the inflamed area. This is accompanied by exudation of fibrinous coagulable serum, and the emigration of red blood cells or so-called diapedesis.

These experimental observations help us to understand the clinical symptoms of inflammation which, in the classical description, comprise *redness, heat, swelling, pain* and *impaired function.* The redness is caused

by hyperemia. The increased temperature is explained by the greater influx of blood and its rapid flow through the enlarged capillaries from the comparatively warmer interior of the body. The temperature of an inflamed outer surface is perceptible only by comparison, and is never above that of the internal organs. The hyperemia, with the exuded fibrinous serum, causes a swelling of the tissues, which, in typical instances, is hard and not easily displaced by digital pressure; the firmness is due to inundation of the tissues and the coagulation of the fibrinous elements. Pain is caused by the distention of the affected tissues and pressure upon the nerve endings of the part; or there may be some chemical agents present which cause the painful irritation. In clinical experience, however, we find that with the relief of turgescence the pain is immediately decreased, or entirely ceases. Each heart beat causes a momentary increase of pressure, and this imparts to the pain a throbbing character which is peculiar to an inflammatory lesion. The swelling can be so great that it will in itself interfere with the normal use of the part. In addition, the pain may cause a reflex protective muscular spasm which contributes to the impairment of function.

This fairly completes the characteristic clinical picture of the immediate local reaction to irritation. We may adduce that the purpose of this reaction is, (1) through phagocytosis to combat the invading foreign agencies; (2) to neutralize the toxic chemical elements; (3) to supply an increased proportion of nutritive elements for the rebuilding and rehabilitating of the injured cells; (4) to carry away débris which may result from the broken down tissue cells themselves, or from the introduced foreign substances; and (5) to prevent the extension of the disease and prepare the way for the process of repair.

An inflammatory process may proceed in one of three ways:—(a) it may subside and terminate in *resolution;* (b) it may go on to *suppuration, ulceration or gangrene* and subsequent healing by the formation of granulation tissue; or (c) it may pass into a *chronic* process.

Resolution. In the first case, resolution, there is practically an inversion of the process already described. The exudates are returned into the blood vessels and lymphatics; some of the fibrinous elements serve as a basis for repair; the wandering cells, having ingested the débris of the injured tissue, or the dead bacteria, return to the blood current, and the symptoms subside. The process of resolution begins, as a rule, only after the irritation has ceased, or has been removed. There may be, however, resolution at one part of the lesion while at another the irritation continues and the inflammation progresses.

Suppuration. The second outcome, that of *suppuration* or the formation of pus, follows when a considerable num-

ber of cells have been killed directly or have been injured so that, as a result, they die in a short time. These masses of dead tissue become separated from the living by a zone of liquefaction which results from the action of a digestive ferment. Thus, the dead tissues, partly liquefied, with dead and living bacteria, white blood cells living and dead, and the fibrinous, serumal blood exudate, form the pus.

Abscess. A localized and circumscribed collection of pus forms a typical abscess. Nature accomplishes the evacuation of pus by digestive liquefaction of surrounding tissue. Mechanical factors of structure and pressure will force this burrowing in the direction of least resistance. The abscess will finally *point* either on the external surface of the body or into a body cavity and there discharge its contents. The space that the pus has occupied becomes obliterated by the formation of new tissues, so-called *granulation tissue,* and the surrounding inflammation which has contributed the defensive cells and exudate will subside by the process of resolution.

The formation of new tissue to replace that which has been destroyed may be initiated during the presence of pus, but complete repair can never be affected until the pus has been evacuated. It is well here to state that repair is not essentially a part of inflammation. Repair of tissue is a distinct phenomenon in its process and also in the activating forces which induce it. These forces are not very distinctly understood at the present time. The two processes of inflammation and repair are closely associated, however, and greatly overlap.

We can now understand that while the inflammatory process is defensive and protective in its purpose, it is both destructive and constructive in its course. There is a destruction of tissue cells in the path of the burrowing of an abscess towards more yielding areas. The constructive factors are the bringing of a larger amount of blood to the part, the neutralization of the toxic or irritating substances, the carrying away of some of these agents, and also the induction of repair and the stimulation of granulation.

Chronicity. The third termination of inflammation is chronicity. Here there are few of the classic clinical symptoms, for the irritant is a mild one and the reaction is low grade. The marked vascular changes do not occur; there may or may not be pus. The response of the tissues is either an overproduction of repair tissue, or a constant, slow circumferential destruction. In the presence of a constant irritant, even though it is of a mild degree, the process cannot go to completion. This picture may be frequently complicated by acute exacerbations, with all the clinical features of *heat, redness, pain, swelling,* and

impaired function. In chronic abscesses where a sinus has formed for the evacuation of pus, the orifice may become obstructed or closed. When this occurs, the retention of pus produces acute exacerbations and evacuation will be followed by subsidence into a chronic low grade reaction. These acute exacerbations should impress us with the fact that a chronic inflammation is a latent and slowly acting danger, which may at any time, and we find that in many instances it does, produce a sudden and extensive lesion.

A thorough understanding of the phenomena of inflammation is essential to a consideration of pathological conditions and the rationale of their surgical relief.

CHAPTER V.

Acute Inflammatory and Suppurative Conditions of the Dental Alveolus.

Inflammatory conditions of the dental alveolus may be classed under two general headings. In the first group may be gathered all those pathological lesions which originate with a diseased tooth or pulp of a tooth and develop into one of the various abscess formations, or tissue degenerations prevalent about the teeth and in the jaws. We shall designate these under the collective term of apical inflammatory conditions and they will be taken up in greater detail later.

In the second group we may place those pathological conditions which originate in lesions of the gingival tissues and the alveolar process and are known under the collective term of pyorrhea alveolaris, or more latterly, as periodontoclasia.

Apical Inflammatory Conditions.

The etiology of apical inflammatory conditions may be non-septic or septic.

The non-septic are: mechanical trauma, such as a blow or some other external violence; traumatic occlusion of the teeth, which may be congenital or caused by improperly coördinated inlays, fillings or prosthetic restorations; or by other factors which interfere with the occlusal plane; a chemical substance forced beyond the apex of a tooth; filling materials or broken instruments projecting beyond the tooth; perforations through the pulpal floor or through a root canal wall. Any of these may establish a point of lesser resistance either through irritation or the outright destruction of the tissues which may be followed by a septic invasion.

Apical septic inflammations, however, are usually dependent upon the decomposition of organic substances, due to bacterial activities. In this event the products of decomposition, the microörganisms or the toxic products of bacterial metabolism may be the irritants, individually or, most likely, in combination. The decomposition of a devitalized pulp or a remnant of a pulp, the putrefaction of organic substances which find their way into the pulp cavity of a tooth from which the organ

itself has been removed, may give rise to gases and acids which, passing through the apical foramen, cause irritation of the peridental structures. The infecting organisms may find their way to these parts through the root canal from the decomposing pulp, or they may be deposited there from the blood current. Gingival tissue destructions, likewise, when unchecked, may include the apical region and so cause infection and devitalization of the pulp. Broken-down roots are nearly always infected, or they may act as physical irritants and cause inflammatory conditions in the alveolus.

As the most prolific source of diseases of the periapical tissue is decomposition of a pulp or other substances within the pulp chamber and root canal of a tooth, the influences which are conducive to the devitalization of the pulp may be regarded as indirect etiologic factors of the conditions to be described.

The agencies or conditions causing devitalization of the pulp are:

1. Deep seated caries or erosions exposing the pulp to chemical, mechanical and thermal shock, or infection from bacteria of the oral cavity.

2. Exposure and trauma of the pulp caused in dental operations.

3. Thermal irritation due to the proximity of large metallic fillings.

4. The action of a chemical poison contained as an impurity in a plastic filling.

5. Traumatic injuries to sound teeth, such as a direct blow, or the continued stress of orthodontic appliances or bridge work.

6. Application of a gold shell crown over a vital tooth.

7. Microörganisms sealed by filling, within apparently good structure of dentin.

8. Deliberate devitalization of a pulp by the dentist, under septic conditions.

9. Pathological conditions external to the tooth, but involving it, such as necrosis, cyst formation, periodontoclasia.

Inflammatory reactions in the alveolar tissues, as elsewhere in the body, are determined by the kind, period and intensity of the irritation, opposed by the vital resistance of the tissues. The resulting phases are analogous to those described in the general description in the chapter on "Inflammation" and their termination may be simple resolution, suppuration, or chronicity. The clinical pictures do not always lend themselves to exact classification.

Septic Apical Pericementitis.

The most common inflammatory conditions affecting a tooth where surgical interference is indicated are acute inflammations of the pericemental

membrane. The septic cases may or may not be suppurating. The patient complains of a throbbing or gnawing pain; the tooth feels elongated, is tender to percussion, and the overlying gum tissues may present signs of discoloration and swelling.

FIG. 3. Acute abscess caused by infected lower second molar. In this case earlier external incision was indicated and was unduly delayed after the pus had burrowed into the submaxillary regions. Note that the deformity is confined to the part which immediately surrounds the pus and that the facial outline is practically undisturbed.

In recent lesions the radiograph is often negative; this determines a state where as yet no gross change in the involved bone has taken place. In the more advanced stages there may be a thickening of the pericemental membrane, and a non-circumscribed rarefaction, radiating fanwise over the apex or the apical third of the tooth which blends into the surrounding bone.

Acute Exacerbation of Chronic Cases.

Chronic cases, of long standing, may assume acute or sub-acute states through the action of inherent or external agencies and may present similar disturbing symptoms. These conditions frequently exist for a long time before

the first disturbing symptoms are manifest. The acute symptoms in all types of cases often subside without any interference and recur periodically until the etiological factor is removed or corrected. In these cases the radiograph usually discloses a thickening of the pericemental

Fig. 4. Typical acute alveolar abscess in the upper bicuspid region. Note the diffused edema extending to and closing the eyelids.

membrane, well defined, circumscribed, larger or smaller area of rarefaction, or complete breaking down of the bone, and, in some instances, an absorption or corroded condition of the root apex.

Treatment of Septic Apical Pericementitis.

Assuming that the causative factor is a tooth containing a putrid pulp, or decomposing organic matter, the course of treatment is partly determined by the consideration whether the tooth is to be retained or removed. In the latter event, early removal is followed by amelioration or the entire cessation of the symptoms. Where the tooth is to be retained, the thorough cleansing of the root canal in which all infected and decomposing substances are removed; the attenuation of the microörganisms by means of therapeutic measures;

and the neutralization of the toxic substances, will often abort the progress of the inflammatory condition. In the presence of a constant mechanical irritant, such as the protrusion of a root canal filling, a compensatory adaptation in the surrounding tissues often occurs.

Fig. 5. Acute abscess pointing upon the palate in a child 7 years of age. It was caused by the infected roots of the temporary second molar. Note the extensive burrowing of the pus and the sagging of the mucoperiosteum passing over the median line.

Acute Alveolar Abscess.

An abscess which is primarily inaugurated in the alveolus of a tooth, and is caused by a dental lesion, is a dento-alveolar abscess.

Symptoms. The general symptoms are those of an acute, violent infection. There is a rise of temperature and the patient complains of malaise and of intense throbbing and burrowing pain, which is accentuated when in a recumbent position. The tooth causing the abscess becomes elongated and tender to touch; often the adjacent teeth are affected in a similar manner, the overlying gums and mucous membrane becoming discolored, swollen, and tender upon pressure.

When pus is formed in the apical region of a tooth, this at first is lodged in the surrounding bone structure. Owing to the unyielding nature of the bone, the tension is considerable until, by the process of pointing, the pus escapes through the bone into the overlying soft tissues. With this, the pressure is decreased, the pain diminishes, and the soft tissues being invaded, the swelling becomes larger.

FIG. 6. Abscess in a young woman 18 years of age. This was caused by a carious infected second molar and was poulticed until it opened upon the face. The pus discharge continued for over three months as the removal of the tooth was overlooked.

Pointing of an Abscess

Pointing is the process whereby pus, seeking a point for evacuation, passes in the direction of least resistance. This is aided by circumferential mechanical pressure and is accompanied by caseation and liquefaction necrosis of the obstructing tissues.

The severity of the symptom is often proportionate, therefore, to the degree of resistance offered by the tissues to the pus in its course of pointing. Hence we find that alveolar abscesses located in the mandible are,

as a rule, more severe and of longer duration than those occurring in the maxilla. The reason for this clinical fact is obvious. While the maxilla is constituted largely of cancellous bone, enclosed within thin plates of compact bone through which the pus finds a more ready egress into the overlying soft tissues, the mandible is formed of rather thick plates of compact bone, enclosing a scant amount of cancellous tissue in which the roots of the teeth are deeply lodged. This is particularly true of the lower third molars. As these teeth are often malposed or impacted, their

FIG. 7. Acute abscess caused by erupting third molar. Note the marked swelling and diffused cellulitis. These conditions should be opened externally even at an earlier stage, as they can be rarely controlled with intra-oral drainage.

roots are so imbedded between the internal and external oblique ridges, or into the ascending ramus, that the abscesses caused by them frequently present rather distressing symptoms. (Fig. 3.)

Acute abscesses in the upper molar and especially the bicuspid and cuspid region usually cause an early swelling of the cheek and the edema may include the lower eyelid, so that the eye becomes completely closed. (Fig. 4.) The swelling in these cases rarely penetrates below the line

of the upper lip. Abscesses of the six anterior teeth, when pointing labially, usually cause swelling and tenderness of the lip and also the ala of the nose on the affected side.

In a comparatively small percentage of cases, the pus points toward the palate. This is most frequently true of abscesses of the upper lateral incisors, rarely of the cuspids and still more rarely of bicuspids and

Fig. 8. Chronic alveolar abscess of about three years' standing in a man 23 years of age. The abscess was caused by a tardily erupting third molar. The pus burrowed underneath the periosteum and evacuated through the fistulous opening in the bicuspid region.

molars. (Fig. 5.) In the lower jaw the abscesses very rarely point toward the lingual aspect. The pus having burrowed through the alveolar process, raises the mucoperiosteum where it may remain lodged between the periosteum and the bone, causing a bulging of the mucous membrane of the buccogingival fold. Very often it spreads to remoter areas.

Surgical Treatment of Acute Alveolar Abscess.

The surgical treatment of abscesses in general consists of removing the cause, evacuation of the pus, and the securing and maintenance of adequate drainage to prevent retention. When the diagnosis

has been made, our effort should be directed to immediate evacuation and drainage.

The consideration of whether the offending tooth is to be retained or not, in a measure will modify our surgical procedure. Where removal of the tooth is decided upon, this should be done *at once*. By so doing, three important steps of the treatment are accomplished. First, the cause is removed; second, evacuation and direct drainage are secured; third,

Fig. 9. The size of incision illustrated here is quite adequate for thorough drainage. The lips of the wound are not gaping nor displaced by the gauze and will leave just a fine linear scar.

the initial focus of infection is rendered accessible for treatment with antiseptic solutions.

Maxillary Abscesses.

For abscesses located in the maxilla, where extraction is the resort, in the majority of cases no other operative measures will be required. Owing to the anatomical relation of the soft tissues connected with and attached to the maxilla, the pus in these abscesses is, as a rule, more localized and evacuation is greatly favored by gravitation. It occurs but rarely that

an abscess in the maxilla points so that external incision is indicated and such a procedure is only rarely justifiable. But where, through injudicious treatment, poulticing is employed, the pus may so penetrate toward the outer surface that an external incision becomes necessary, or it may of itself break and evacuate on the external surface. (Fig. 6.) Here the extraction of the offending tooth will almost invariably secure sufficient drainage. When the pus seems copious and has penetrated through the bony walls of the alveolus and is lodged between the periosteum and the bone, drainage through the tooth socket is not always adequate. In this event the removal of the tooth should be supplemented with a free incision of the mucoperiosteum. Drainage should be maintained through both channels. Where the radiograph shows no pathological change in the bone of the involved area curetting is contraindicated. Where there is a chronic degeneration of the surrounding bone tissue this should be removed by means of a curette until healthy areas are reached.

Curetting In Acute Alveolar Abscess.

Curetting should always be performed with great discretion and confined to the removal of those substances which result from the degenerating processes and suppuration, and those tissues which have become so impaired that they may act as latent foci of infection if left in place and that their return to normal is not likely to occur. Care should be taken in the surgical procedure to avoid, or minimize injury to the tissues which are surrounding the pus, as these tend to limit the extent of the infection and are active in repair.

Mandibular Abscesses.

In the mandible, once the pus has reached subperiosteal areas, the process rapidly becomes more diffuse and more complicated, and cannot always be controlled by the removal of the offending tooth alone. While it is still confined between the periosteum and the bone, the immediate removal of the offending tooth and an intra-oral incision may abort the pointing of the abscess externally. These cases frequently result in aggressive diffuse cellulitis, involving the submaxillary region and the entire side of the neck. (Fig. 7.) Sometimes the pus may burrow and the cellulitis extend as far down as the clavicle. The pain is severe; the tissues appear discolored, presenting all symptoms of an acute inflammation; the swelling becomes boggy and pits upon digital pressure. With careful palpation fluctuation may be discerned indicating the presence of pus. In this way the most dependent point of the fluctuating area, where the incision is to be made, can be determined. When the pus has burrowed into the submaxillary regions, the case can but rarely be controlled with intra-oral incision and drainage must be established externally. Too much emphasis cannot be

laid upon the advantage of early incisions for securing evacuation and adequate drainage of pus, whether this is to be done intra- or extra-orally.

Cases are frequently seen where incision is delayed in order to avert scaring the patient. Experience shows, however, that early incision leaves a less marked scar, as the tissue destruction caused by a well executed incision is infinitely less than is caused by the pointing of an abscess. When an abscess is permitted to break of its own accord, the scar becomes attached to the bone, or a pit forms which is disfiguring and impossible to correct. (Fig. 8.)

If the retention of the tooth is decided upon, the tooth itself should be treated with the accepted therapeutic measures, which largely consist of the cleansing, sterilization and sealing of the root canal. The root canal itself may provide in some cases sufficient drainage. If this is inadequate and surgical interference becomes necessary, measures should be directed towards the evacuation of the pus as described above. If the pus is still confined in the bony cavity, evacuation can be secured by raising the mucoperiosteum and cutting through the outer plate of the alveolus with a surgical bur or a chisel over the apex of the tooth. Dental treatment should be deferred until all active symptoms have subsided and are thoroughly controlled. After the root canal has been freed from all débris and infected pulp tissue, it should be thoroughly sterilized and ultimately hermetically sealed at its apical end.

Technique of External Incisions.

Abscesses of the lower jaw, particularly of the molar region, are usually complicated by partial or complete false ankylosis of the jaws. Whether an intra-oral or an extra-oral incision is to be made, a general anesthetic is indicated. For extra-oral incisions the operative field should be prepared by washing the skin surface with a solvent such as benzin or ether, or tincture of green soap and warm water. This is to be followed by a germicidal agent, such as bichlorid of mercury, of 1 to 2,000 or 1 to 5,000 strength, or 70% alcohol, and painted with tincture of iodin. After this, it should be surrounded by sterile cloths or towels and none but surgically clean objects should be brought in contact with this now sterile field of operation. The operative field in itself should be likewise protected from all possible sources of contamination, as the chain of asepsis is often broken in these operations by the anesthetist in the application of the inhalers.

The line of incision should be made parallel with the lines of the features, or with the natural skin creases. (Figs. 9 and 10.)

The lancet is passed through the dermis, the superficial fascia and

the outer layers of muscle tissue. If the pus has not been reached at this point, deeper penetration with the knife must not be attempted because of the danger of severing some important structures that traverse the deeper strata. A pair of blunt scissors, of the Mayo type, may be inserted through this incision until pus is reached. These are then opened widely in several directions, so as to break down all tissues which may

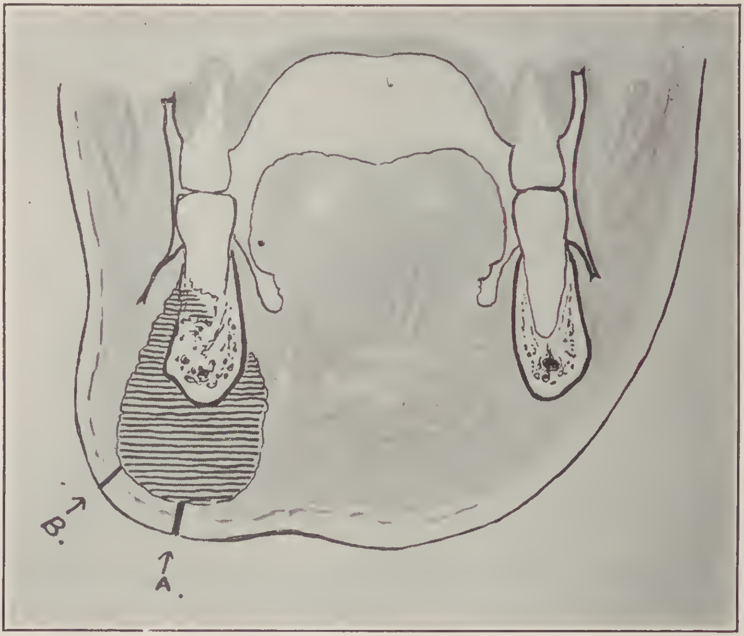


Fig. 10. Diagram showing the anatomical relationship of the parts and their displacement by the pus. The lowest part of the pus collection is at (A). The more marked point of fluctuation is at (B) where the abscess should be incised. When the distention of the tissues is reduced this will be the more favorable point for drainage.

be dividing the abscess into pockets.* This can be done with a pair of blunt scissors or with a large curette. The external incision may now be enlarged to the size needed for adequate drainage. In all this procedure undue laceration or invasion of the tissues surrounding the pus collection must be carefully avoided and the surgical trauma should be reduced to the minimum consistent with thorough evacuation. It is this tissue surrounding the abscess which initiates repair and finally brings about the obliteration of the abscess cavity.

* The scissors should never be closed in the wound.

Frequently it is found that the approximating surface of the bone communicates with the abscess cavity. Curetting of this, or any interference with the bone through the abscess incision, is contraindicated. Additional injury to this already impaired bone, probably devoid of periosteum, may lead to necrosis.

If ankylosis is present, the patient's mouth must be pried open under the same anesthesia, and the infected tooth removed. The socket should be cleansed of all pathological and non-vital tissue with a curette.

Both the tooth socket and the abscess cavity is thoroughly irrigated with a mild antiseptic solution and lightly packed with iodoform gauze. The gauze is inserted so that the entire abscess cavity is loosely lined without undue pressure. The gauze should be all in one piece; if more than one length is used, this must be remembered, and an end of each piece should project through the outer orifice. Many troublesome abscesses have been traced to forgotten pieces of gauze left in the deeper recesses of such a cavity.

The external wound is covered with a gauze dressing wet with a boric acid solution; this is covered with gutta-percha tissue and bandaged into place, or secured with adhesive strips.

Postoperative Treatment.

The postoperative treatment consists in changing both the external dressing and the iodoform packing. The abscess cavity is thoroughly irrigated with a non-escharotic and non-irritating solution. A sterile normal saline, boric acid 4%, or a mild iodin solution may be used. In doing this we depend more upon the mechanical cleansing than upon the actual germicidal value of the irrigating medium. Solutions which are actually bactericidal are also destructive of tissue cells, and will hinder repair. The one agent that is most perfectly balanced as to the potency of its bactericidal action and its acceptability to the tissue cells, is the normal inflammatory serumal exudate elaborated by the body itself, and we cannot hope to adjust so finely a chemical preparation.

Care must be taken that in the irrigation, no pressure, undue traumatism nor disturbance of this now progressively active repair tissue be created. Insert the blunt nozzle of the irrigating syringe without obstructing the entire opening so that the irrigating solution may escape without creating pressure. Pus coagulates and necrotic tissue fragments will thus be gently lavaged from the cavity. The irrigation should be continued until the return is clear, except for the discoloration due to hemorrhage. The subsequent iodoform packing should be rather loose and so introduced that it acts as a wick and does not clog up the external orifice. The tooth socket may be irrigated and packed in a similar manner.

The irrigation and dressings are repeated at twenty-four hour intervals until the more active symptoms have subsided. Thereafter this is repeated every forty-eight hours and just sufficient packing is inserted to keep the drainage space patent until the cavity is obliterated by granulation.

There should be, in general, a marked abatement of the more distressing symptoms within twenty-four hours after the operation. Where the symptoms do not progressively subside, retention of pus, due to one of the following conditions, is to be suspected: (1) the drainage is inadequate, due either to the size, or the position of the original incision; (2) faulty packing, causing a damming back of the pus and clogging the orifice of evacuation; (3) a pus pocket may not have been reached and is acting as an independent abscess; (4) or there may be an independent abscess in an adjacent point which might be reached through the first incision, or else a separate incision and treatment may be indicated. Secondary incisions are at times necessary when the abscess is deeply located in the lower part of the neck. Because of the great tendency to diffusion in these regions "counter drainage" may be essential and is established by a free passage between the upper and lower incision.

CHAPTER VI.

Chronic Inflammatory and Suppurative Conditions of the Dental Alveolus.

To the more comprehensive further study of the subject, the consideration of the present status of pulpless, or devitalized, teeth will prove helpful. That pulpless, or devitalized, teeth may act as foci of infection and as such become etiological factors in the causation of systemic diseases, or lesions of remote vital organs, is not a new thought. The subject has gained what would seem a disproportionate impetus, however, within recent years, through a closer study of focal infection in general. The findings of the numerous investigators, clinicians, and research workers in both the medical and dental professions leave no doubt regarding the validity of the contention that the teeth are among the principal sources of infection. Many aspects of this subject are so beset with complexities presenting so many moot problems that the subject can scarcely be considered settled at the present time.

The difference in the views expressed by the various investigators has created a veritable chaos about which, what appears to be an internecine contest, is being waged, and in which millions of human teeth are being wantonly sacrificed.

The advocates of these different views may be classed in three groups: (1.) Those who believe that all pulpless, or devitalized, teeth are pathogenic and analogous to infected foreign bodies and that as such they must be radically removed in every instance. This is done with no attempt at discrimination, based on clinical findings or radiographic examination. (2.) In the second group we may classify the men who are guided entirely by the utility of the tooth, by clinical signs and the occasional radiographic examination of sporadic cases. (3.) In this group we may place those men who exercise individual selection in all cases. This selective discrimination is dependent upon the following considerations: (a) the general health of the patient; (b) the probable susceptibility of the patient towards infection; (c) the age, sex, and the probable vital resistance of the patient; (d) the nature of the infection and its clinical manifesta-

tion; (e) the extent of the pathological condition and the tissues involved as determined by clinical findings and radiographic examination; (f) the number of devitalized teeth present in the mouth; (g) the history of the tooth itself and the condition of its structure; and finally, (h) the comparative value and the importance of the individual tooth.

It is quite generally conceded by all who have studied the subject that infected teeth may act as foci of infection; on the other hand it is maintained, with equal justification, that not all pulpless, or devitalized, teeth if properly treated are essentially diseased or pathogenic. It logically follows, therefore, that the men who adopt a selective individualization are most likely to be right, and the method commends itself in the rational consideration of the subject.

It is often argued that the loss of a tooth is, comparatively, of minor importance where the patient's general health, or a lesion of some vital organ, is concerned. This truism, however, should not be permitted to impel us to a haphazard, wholesale removal of teeth and must not overbalance our better judgment as to the value and the utility of the teeth in the human economy. In contemplating the subject and its many angles and aspects as they impress us in our daily contact with patients, we are keenly conscious of the fact that the loss of a useful tooth is an irretrievable, permanent loss and that many would more cheerfully submit to what might be considered a more serious operation instead.

The further treatment of the subject will be based upon the assumption that a great many pulpless, or devitalized, or infected teeth must be removed and that a great many can be conservatively treated, cured and retained as innocuous members of the host.

Chronic Dento-Alveolar Abscess.

Chronic alveolar abscesses may be loosely grouped into the fistulous and the non-fistulous types.

Fistulous Type of Abscess.

In the fistulous group belong those abscesses which have passed through the acute stage and in which the pus has established for itself a point of evacuation, thus passing into a chronic state. The presence of the etiologic factor maintains the abscess and, because of the drainage, the disturbing symptoms may be slight, periodical, or entirely absent. The point of evacuation may be alongside the gingival margin, upon the gum tissues about, or at some distance from the diseased tooth. It may evacuate into the maxillary sinus, into the nasal cavity (which is rare), or upon the external surface of the face. (See Figs. 6 and 8.) The discharge may be copious or scant, constant or periodic. While the orifice stays

patulous the disturbing symptoms are very slight, or absent; if the orifice closes, the retention of pus causes an exacerbation with the characteristic symptoms of an acute abscess. The turgescence may cause the orifice to reopen, or gentle pressure will do it; upon evacuation of the pus, the symptoms subside until retention again occurs. This varying picture is typical of a chronic abscess having a sinus. This pathological process is usually accompanied by suppurative osteitis and the radiograph shows destruction of the surrounding bony tissue. In many cases, a well defined abscess sac will be found, suggesting cystic degeneration, or tissue proliferations may form which do not appear to be hollow, and rather resemble a pericementoma.

FIG. 11. Lower left first bicuspid, containing an infected pulp. Note the thickening of the peridental membrane and hyperplasia of the corresponding peridental lamella.

FIG. 12. Infected upper bicuspids with smaller types of pericementomas about their apices.

Non-Fistulous Abscesses.

The non-fistulous type of abscesses may or may not be preceded by an acute stage. They are often discovered only in a radiographic examination. They may at any time, however, assume an acute or subacute state, when disturbing symptoms arise. They are invariably associated with devitalized teeth and their insidiousness lies in the fact that they may exist for any number of years, causing no clinical signs, nor symptoms. In the absence of these, therefore, every pulpless, devitalized, discolored or crowned tooth, or teeth containing large fillings should be radiographed to ascertain their condition.

The pathological state of the tissues involved as disclosed by the radiograph, may be a mere thickening of the peridental membrane and hyperplasia of the corresponding peridental lamella. (Fig. 11.) There may be a pericementoma (Fig. 12) or cystic degenerations are quite common. (Fig. 13.) The pathological process is not always confined to the

affected tooth alone, but quite frequently progresses until a considerable area of bone and probably some of the adjacent teeth become involved. (Fig. 14.) The overlying mucous membrane very often appears normal. In some instances there is a marked discoloration. This should always be noted as a likely sign of a chronic pathological process underneath. Such a condition can be detected by digital pressure in those cases where the outer layer of bone is thin or thinned out.

Fig. 13. Infected upper right lateral incisor presenting what may be considered a smaller type of cystic degeneration.

Fig. 14. Involvement of two adjacent teeth by the spreading of the diseased area from a primary focus. The source of the infection was most likely the lateral incisor, as the cuspid and central still gave signs of a degree of vitality.

As in acute, so in chronic cases, in disposing of pulpless or infected teeth, one of two measures may be pursued; i.e., radical or conservative.

Radical Treatment of Chronic Abscesses.

We will consider first those conditions in which the retention of a pulpless or infected tooth is contraindicated. We may here state that its removal and the eradication of the infected area surrounding it must be based on sound pathological and surgical principles. It is essential therefore that the operator should thoroughly understand bone tissue, its histological structure, its reaction to injury, and the possibilities of its repair and regeneration.

The radical measure comprises the removal of the tooth and all palpable pathological conditions associated with it. As there is a variation in these diseased areas, it must be clear that the extent of the operation is to be determined by the nature and the extent of the pathological condition.

The theory that in the removal of an infected tooth a goodly amount

of the surrounding bone also must be removed has neither a pathological nor a surgical foundation. This is advocated and practiced on the assumption that the bone about an infected area must also be infected. It may be conceded that some microörganisms will find their way into the surrounding tissues, but it is impossible at the present time to grossly determine just where the invasion terminates. The focal infection theory in itself presupposes that the infecting organisms are not confined to the immediate surroundings of the primary nidus. Besides, bone tissue is not a constant structure, but is subject to continual breaking down and building up. Incidentally, much of the damaged tissue is constantly being carried away and replaced with new bone.

Here, as elsewhere, we must depend more upon the protective mechanism provided by Nature to take care of all non-concentrated infectious agencies, than upon uncertain and often harmful attempts at actually removing them. Clinical evidence has proven that such ultraradical measures often open up new channels which tend to add to the local spreading and to the possibilities of absorption of the infection. Were we to leave out Nature and her protective mechanism from our consideration and base our surgical procedure upon such erroneous concepts in pathology, a great many good teeth adjoining an infected area would be sacrificed; the maxillary sinus, the nasal cavity, the mandibular canal would very often, necessarily, be invaded and many jaws would be mutilated in an unthinkable fashion.

Where these facts are overlooked the operator is laboring under a delusion which is inconsistent with rationality, for we must assume that any one, or all approximating surfaces are uniformly invaded. Fortunately the most ardent advocates of such a technique fall short in their aggressions and their own contradictions prove their fallacy. The best of surgeons, trustfully courting her aid, are but the willing and respectful handmaids of Nature. Those who are studying her ways and who work hand in hand with her are less frequently disappointed than those who have the presumption to assume too much of the burden.

A complete radiographic examination is always essential in the treatment of pulpless, or devitalized, teeth. The radiograph may be negative; this, however, must not be taken as a proof that there is no infection present. This simply means that there is no radiographically demonstrable change in the bone tissues surrounding the tooth; or the radiograph may have been taken at such an angle that the lesion is obscured, or not disclosed. A pulpless, or devitalized, tooth in which the root canal work seems faulty, the obturation being incomplete, or entirely lacking, should be regarded as being infected. It is also contended that a tissue change,

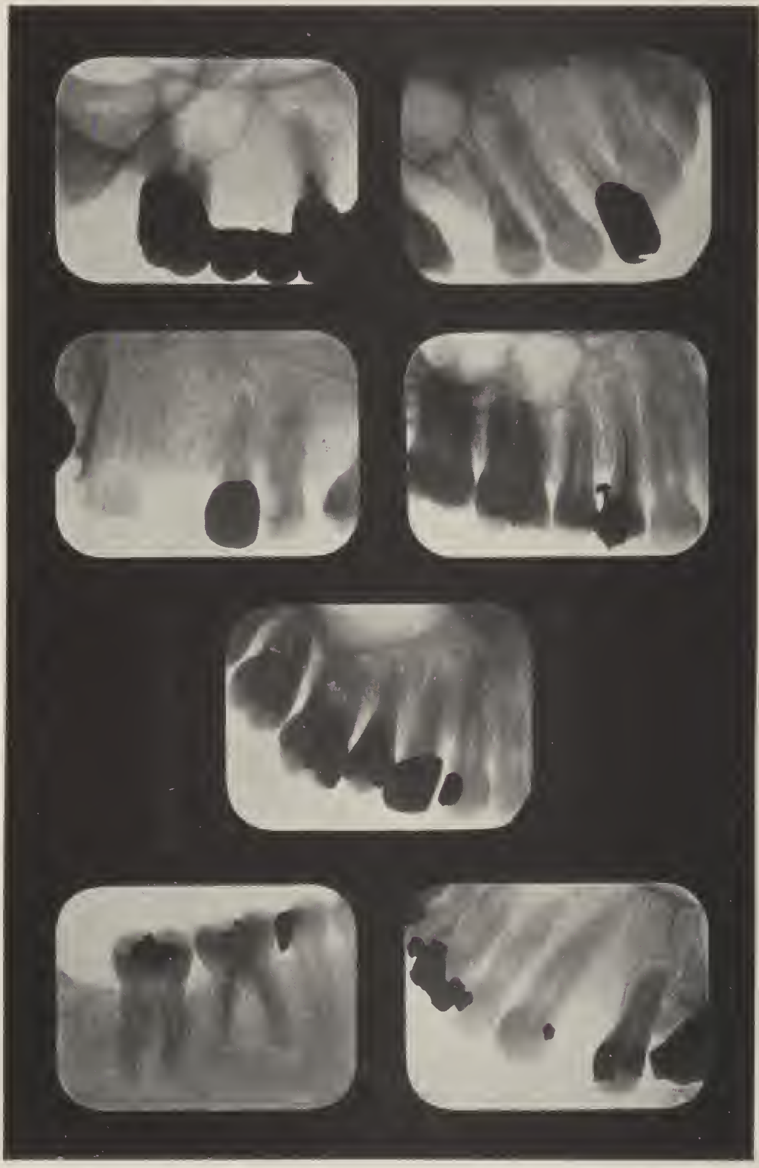


Fig. 15. The infected teeth in this series present types of lesions in which the gross change seems to be confined to the peridental membrane. Complete removal of the teeth alone is indicated. Any degree of curetting or bone removal is superfluous.

expressed as a bone absorption, or lack of bone substance about the apex of a pulpless tooth, is not necessarily an infected condition; that infection is a matter of microscopy and not of radiography. We know of no nor-

FIG. 16. In this series the infected teeth present smaller and larger pericementomas. These often remain attached to the teeth in their removal. In this event no curetting is necessary. If it becomes detached and remains in the bone it can be removed with a fine curette through the tooth socket.

mal condition which will produce such a phenomenon and where it cannot be explained as a radiographic error, as a normal or anomalous anatomical relationship, or in the absence of prior operative history, it should be regarded as a pathological condition, most likely caused by infection.

Infections Limited to Teeth and Pericementum.

From the standpoint of surgical technique we may differentiate chronic infections which are confined to the tooth and the pericemental membrane. which is often thickened and shows evidence of degeneration. In these cases the removal of the tooth and the pericemental

FIG. 17. Smaller and larger cystic degenerations. In these, blind curetting through the tooth socket should not be depended upon. The part should be clearly exposed and the cyst completely removed. (See Cysts.)

membrane is the only measure that is necessary. It is of paramount importance that no part of the tooth or diseased portion of the peridental membrane which may act as a latent focus of infection should be left in the alveolus. (Fig. 15.)

Circumscribed Areas of Infection.

In the second group we may consider those conditions in which the infection and diseased area are circumscribed and confined within the limitations of a pericementoma (Fig. 16), or a cystic degeneration. (Fig. 17.)

These tissue proliferations are the result of a productive inflammation and are very probably part of the protective mechanism of the body.

This suggestion is strongly supported by the clinical experience that in the conservative treatment of these teeth to which they are attached with removal of the source of the infection, retrograde changes and often complete obliteration and replacement with bone is observed. Their pathological significance lies in the fact that they contain microörganisms and

FIG. 18. Cases of suppurative osteitis having no well defined organized tissue limitations. Note particularly the jagged edges of the bone, the enlarged bone spaces, and the irregularity of outline.

their toxic products, whence they may be carried away by the blood stream or the lymphatics and so disseminated throughout the system.

A pericementoma, or, as it is more commonly called, a dental granuloma, is not a neoplasm in the true sense of that term. It is rather the result of a productive inflammation induced very probably by the irritation of microörganisms of a low grade of virulence, such as the streptococcus of the viridans group, which is very frequently found associated with these areas. Depending upon the nature of the infecting organisms a pericementoma may or may not contain pus. It may be solid and composed entirely of connective tissue, or it may have a lumen. The inner

surface often presents epithelial chains or rests, dipping down into the deeper strata of the tissue. In others, the inner surface is partly or in its greater part covered with epithelium, showing tendencies towards a cystic

Fig. 19. The diseased teeth in this series present a complete degeneration of the peridental membrane, a breaking down of the peridental lamella, and invasion of the surrounding bone. In these, the removal of the teeth must be supplemented by the removal of the diseased and degenerated tissues.

degeneration. The theory that they are the precursors of radicular cysts is maintained by some investigators and is rather suggested by clinical findings.

The bone immediately surrounding such a pathological area appears more dense and presents a fairly smooth surface. It most properly may be considered as a hyperplasia which often occurs in the vicinity of, or within, inflamed bone and is probably dependent upon an increase of the bone lamellæ, or an increase in the calcium salts, or both. It has not been demonstrated as yet that the percentage of calcium salts content is greater in this bone than it is in normal bone.

The treatment of these cases consists of the removal of the tooth and the enucleation of all tissue proliferations induced by the pathological process. Small growths often remain attached to the extracted tooth. In these cases no further surgical measures are necessary. Small growths which remain attached to the bone cavity may be removed through the enlarged tooth socket by means of a curette. There are many instances, however, in which the pathological area is extensive, or not quite clearly outlined. In these cases it is more advisable to reflect the overlying mucous membrane, remove a portion of the outer plate of the bone and expose the operative field to view. The growth is completely removed and the surrounding bone is left intact.

Uncircumscribed Areas of Infection.

Thirdly, there is a type of cases in which the pathological area is not circumscribed. (Fig. 18.) These are usually suppurative and the pus, mingled with unorganized, sickly, granulation tissue, is lodged in an irregular, jagged bone cavity. The radiograph does not show a clearly defined radiolucent area and we must depend upon clinical signs for our guidance. This often consists of gross changes in the bone structure, marked with discoloration and the permeation of the enlarged bone spaces with pus. The part should be well exposed to view. The bone which is impaired readily crumbles under the pressure of a steel instrument; where the bone presents a healthy appearance removal should terminate.

Lastly, there are types of degenerative conditions about the teeth which cannot be classified with accuracy. The initial lesion may be at the gingival margin which extends until all of the peridental membrane is involved, and the pulp becomes infected or devitalized, so that the tooth becomes virtually a foreign body and is gradually exfoliated. In other cases there may be a coexisting apical lesion and the two progressively merge until the tooth is completely surrounded by pathological tissue. The peridental membrane and the cementum are badly degenerated, or entirely destroyed by the suppurative process. The peridental lamella is completely broken down, the surrounding bone is somewhat more deeply invaded, and there is no circumscribed line of demarcation formed. (Fig. 19.) The extraction of the tooth should be followed by the removal of all broken down tissues and curetting of the bone until healthy areas are reached.

Indications and Technique of Root End Amputation.

Treatment When Tooth Is Retained.

Where the tooth is to be retained, there are three possible courses of procedure:

(1) Root canal therapy alone will suffice in the type of cases where the tissues involved, comprising the cementum, the pericemental membrane, and the alveolar process, are damaged only to such an extent that with the removal of the infecting agencies, their return to normal and their physiological coordination may be hoped for. (Fig. 20.)

Fig. 20. In these cases root canal therapy alone will clear up the infection.

(2) Curetting is indicated in those cases where there is no complete denudation nor corrosion of the apex of the tooth, and the involved area is too large, probably containing a larger amount of degenerated and broken down tissues than might be expected to be carried away by natural processes or eliminated by drainage through the root canal. (Fig. 21.) The root canal is first sterilized and thoroughly sealed; the apical region is then exposed by making an incision and raising the flap of mucoperiosteum. The overlying bone tissue is removed by means of gouges and rongeur forceps. When the parts are well exposed all the diseased tissues are removed by means of spoon-shaped curettes until healthy tissues are reached.

When the area is small, packing of the cavity may not be necessary. If the area is so large that ready repair is not likely to occur, the cavity should be dressed with iodoform gauze and irrigated until cicatrization is fairly well under way.

FIG. 21. Types of cases in which the root is not involved to any extent and the pathological area, though confined to the bone, is larger than might be expected to clear up without surgical interference. Curetting alone is indicated.

Root End Amputation (Apicoectomy).

Where the apex of the tooth and the pericementum are irreparably injured or destroyed, the cementum and the dentin become exposed and infected and show signs of absorption and corrosion; there is a decided break in the continuity of the peridental lamella (cribriform plate) which merges into an area of bone absorption. Where this condition obtains, we cannot hope that the once denuded surface of the dentin will again be covered with cementum and pericementum, and that physiological coördinate relationship between these tissues and the alveolar bone will ever be restored. It must be clearly understood that while all highly specialized tissues have potentialities of repair if merely injured, they have but a slight power of regeneration if once destroyed. To accurately determine clinically just where the one condition ceases and the other begins is practically impossible. It is good practice therefore to remove by the operation of amputation all such portion of the affected tooth root upon which the cementum and pericementum are in a doubtful state, or completely destroyed. Where such measure cannot be carried out with a fairly definite hope for a favorable final result, conservative measures should be abandoned.

Root end amputation must not be looked upon as an abscess cure. It

is essentially an auxiliary measure for the eradication of pathological tissue proliferations and detritus which result from protracted suppurative and degenerative processes. In the removal of these should be

Fig. 22. Smaller and larger pathological areas in the apical region. The root ends are denuded, some of them resorbed and they merge into the pathological area. A normal attachment and physiological coördination between these parts and the surrounding tissues cannot be established and therefore amputation is indicated.

included such portion of the tooth root as has been rendered permanently diseased, and the presence of which must exert a baneful influence upon the surrounding tissues.

The most frequent indications for this operation are conditions where, through a pathological process, portions of the pericementum are detached or destroyed; the cementum becomes infected and partly or completely

disintegrated, leaving the underlying dentin in a denuded or semi-denuded state.

The pathological conditions which bring about these tissue changes are almost always chronic in their course and they may or may not be

FIG. 23. Infected upper first molar in a man 32 years of age. The mesial root is completely denuded. In cases of this type if the lingual and distal roots can be adequately treated and their enveloping tissues are in favorable condition the mesial root may be amputated.

FIG. 24. Pericementoma upon the lingual root of the upper first molar. The apex of this can be amputated provided complete sterilization and sealing of the remaining parts can be achieved.

FIG. 25. Types of cases in which complete sealing of the root ends was impossible because of curved formation of the root, or some physical obstruction. The root is sterilized and filled as far as possible and the unfilled part amputated.

accompanied by suppuration. The area may be filled with unorganized masses of tissue, or it may be occupied by a pericementoma or a radicular cyst.

Black * maintains that when this occurs, the normal physiological coordination of the tissues concerned cannot take place, and that such a process can be induced by no therapeutic measures. Like all specialized tissues, so the cementum and pericementum are capable of repair when

* Black: *Special Dental Pathology.*

injured, but they have a very limited power of regeneration when destroyed. Black believes therefore that such a portion of a root, devoid of cementum and pericementum, or where the tissues are impaired to such

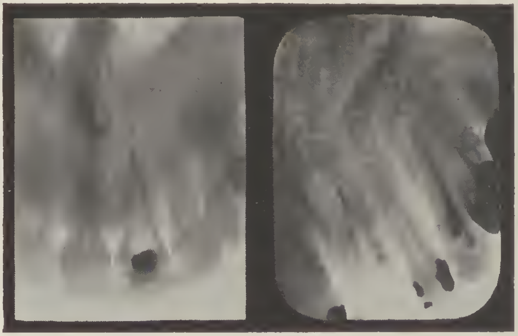


FIG. 26. Broaches broken in the apices of roots. Remove if possible and treat the root. If removal is impossible fill completely up to the broach and amputate the part containing the foreign body.

FIG. 27. Perforation through the side of the tooth close to the apical third. Amputation just below the perforation indicated.

an extent that a return to normal cannot occur, acts virtually as an irritant not unlike an infected foreign body.

In operation, upon exposing a root which is so affected, it is found that it presents a smooth, almost polished surface, or a corroded and absorbed condition; still others have smaller or larger patches of cementum in a state of disintegration adherent to the dentin. This portion of a root is projecting into a diseased area and offers no support whatever to the maintenance of the tooth in position. (Fig. 22.)

FIG. 28. Root amputation is contraindicated because of the proximity of the maxillary sinus, although with care it might be done without invading the cavity.

FIG. 29. Types of cases in which root amputation is contraindicated because of the scanty tissue whereby the tooth might be retained.

Besides these conditions, the following will prove to be amenable to root end amputation:

(1) Where an individual root of a multirooted tooth has lost its peridental membrane and alveolar process through extensive pyorrhea, or

Fig. 30. Types of cases in which root amputation is contraindicated because of extensive absorption of the alveolus, and infection and destruction of the cementum and the pericementum.

through atrophy; or when one of these becomes infected and thorough therapy cannot be done. This may be amputated after the portions to be retained have been adequately treated. (Figs. 23-24.)

(2) Where the tortuosity of the root does not permit of thorough cleansing and sealing, the canal can be filled as far as possible, and the remainder of the root should be amputated. This would be more of a prophylactic or preventive measure. (Fig. 25.)

(3) Where a broach, broken at about the apical third of the root canal, prevents its proper treatment, the part containing the foreign body may be amputated after the remainder has been properly cleansed, sterilized and filled. (Fig. 26.)

(4) Where the root has been perforated at about its apical third, this may be amputated at the perforation. (Fig. 27.)

Contraindications for Root End Amputation.

(*a*) The operation is contraindicated in all cases where the general health and vital resistance of the individual are low, or where for any reason retaining a devitalized tooth is contraindicated. (*b*) If the tooth structure shows signs of disintegration or marked discoloration, suggesting an infection of long standing, this operation must

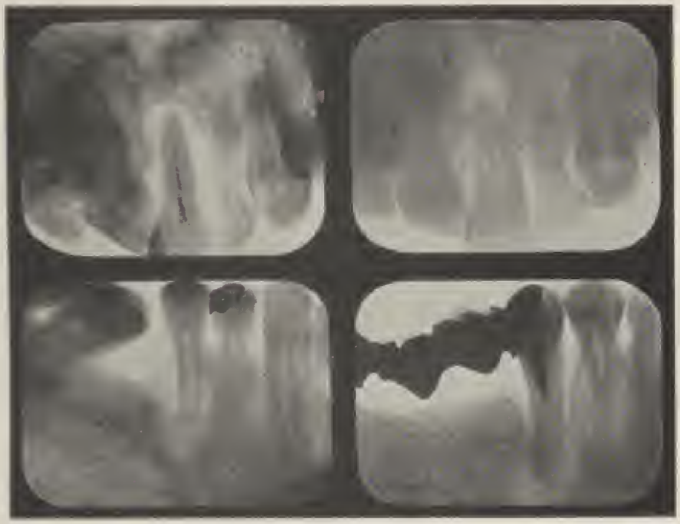


FIG. 31. Types of cases in which root amputation is contraindicated because of passage of communication between apical and gingival areas. In some of these the infection began at the apex and passed towards the gingiva; in others the other way round; in still others infection may have existed at independent points and with their progress they coalesced.

not be used, even if the surrounding bone conditions seem favorable, as evidenced by the radiograph. (*c*) An inaccessible position of the tooth, or the proximity of important structures such as the inferior dental canal or the maxillary sinus, are contraindications for the operation. (Fig. 28.)

In the selection of cases, care must be taken that the infected tooth root still retains a goodly amount of healthy pericementum attachment, apico-gingivally on its entire circumference. Where such attachment is lacking, or where there is a path of communication between the tooth apex and the buccal cavity along the gingival margin, produced by the progressive tissue destruction of the abscess, by pyorrhea, a lateral abscess, or by traumatism, this operation should not be undertaken. (Figs. 29, 30 and 31.) Reinfection will always follow and the tooth will have to be removed. Lastly, it must be understood that where thorough steriliza-

tion of the tooth structure to be retained cannot be secured, this operation is not to be undertaken.

The operation of root end amputation recently has been quite tersely discredited in current dental literature, as well as in society discussions.

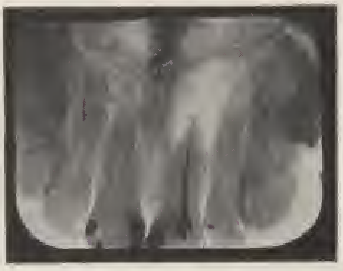


Fig. 32. Presents what may appear to be a good root canal filling. Closer inspection shows that it is faulty and this is indicated by the presence of the infection and the pathological area. Root amputation would be a failure unless it is preceded by the complete removal of the old filling, sterilization of the root canal and its complete sealing.

Fig. 33. Types of cases in which root canal therapy alone should not be depended upon because of complete denudation of the apices. They are favorable cases for root amputation, but the pivots must be removed first and the root canals treated and filled.

These expressions of disappointment reach us from varied sources, but unfortunately the real cause of dissatisfaction must be guessed at, as analytic, scientifically tenable reasons are not offered in explanation. The condemnation generally comes from those men who do not approve of

retaining a devitalized tooth under any circumstances; secondly, from men who meet with a large percentage of failures.

Causes of Failure.

In a symposium upon the subject * compiled by Dr. R. Ottolengui and published in *Dental Items of Interest,* to which men with many years of experience and whose names are fairly identified with this work, con-

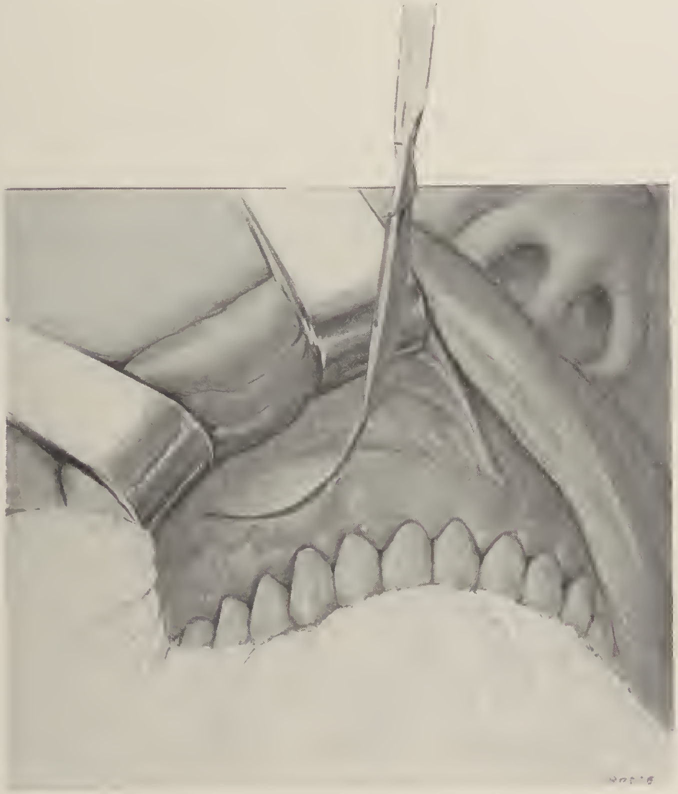


FIG. 34. Incision of the mucoperiosteum for amputation of the first bicuspid root.

tributed, the consensus of opinion was that, in properly selected cases, the favorable results are practically 100 per cent. It is the author's impression that the greatest number of failures can be traced to: (*a*) the utter misunderstanding of every vital phase of the subject: (*b*) many have grasped this as a sort of a short cut for the removal of awkward apical infections; (*c*) the improper selection of patients as well as individual

* *Dental Items of Interest,* 1922.

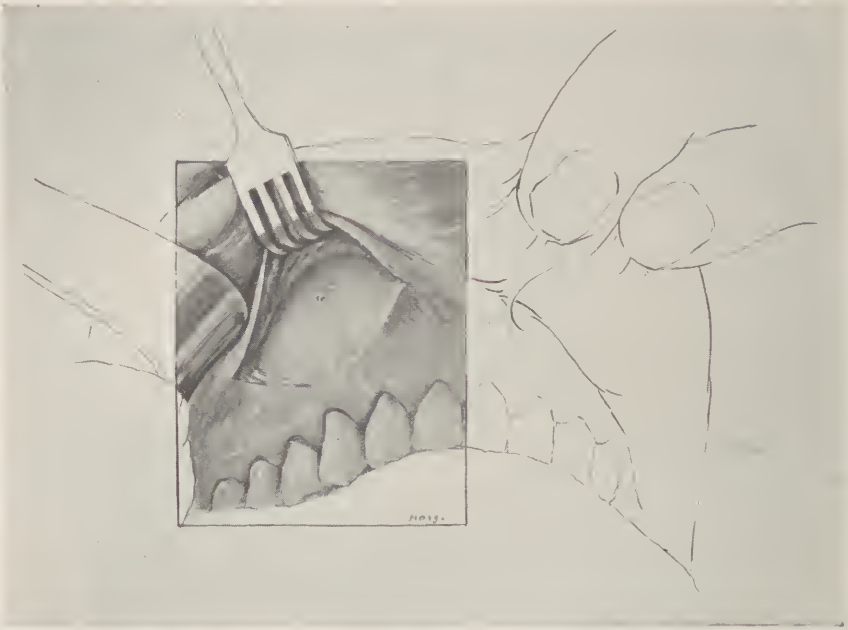


FIG. 35. The mucoperiosteum retracted and the bone exposed. Note the alveolar ridge indicating the outline of the root and thinning out of the bone over the pathological area.

cases; (*d*) negligence in some preliminary measures preceding the operation; (*e*) faulty operative technique; (*f*) faulty postoperative treatment.

It must be definitely understood that without precise root canal work this operation is foredoomed to failure, and where this cannot be secured it should not be undertaken under any circumstance whatever. In other words, all conditions which conduce to reinfection must be absolutely eliminated first. Regardless of what the past treatment of the tooth might have been, whether the tooth is pivoted, inlayed or filled; whether the root or roots appear completely empty or partly or entirely filled, the first step must be to render, the tooth substance proper, innocuous. This is accomplished by first removing all restorations and the root canal contents; the pulp chamber and the root canal or canals are mechanically cleansed, next sterilized and effectively filled and sealed.

We find numerous cases in which the root canal work seems fairly complete or even perfect. These radiographic appearances cannot be relied upon in this event, as the presence of infection decidedly indicates the presence of sepsis in the root canal or in the filling material itself, or in both. (Figs. 32-33.)

FIG. 36. The outer plate of bone removed; the pericementoma and the root apex exposed.

Technique for Apicoectomy.

It is my custom to have all therapeutic and dental operations, including the prosthetic restorations completed, and to amputate the root end subsequently, so that when cicatrization ensues, the tooth is not disturbed again. From this we infer that root end amputation is preceded by a series of steps. To secure success, each one of these must be perfect.

Let us assume, then, that we have selected a case where we have determined upon the necessity for root end amputation. By means of a radiograph, we ascertain that the root has been well filled to the apex. Note the direction and position of the root; the proximity of the adjacent teeth; the amount of tissue destruction. With a sharp lance, cut through the mucoperiosteum to the bone, and produce a semi-lunar incision with its crescent towards the crown of the tooth. The line of incision should be made at about the apical third of the root to be amputated. The crescent is to be deep enough to permit of a convenient retraction of the mucoperiosteal flap in exposing the bone. (Fig. 34.) Flaps with narrow pedicles will often slough away and so complicate the

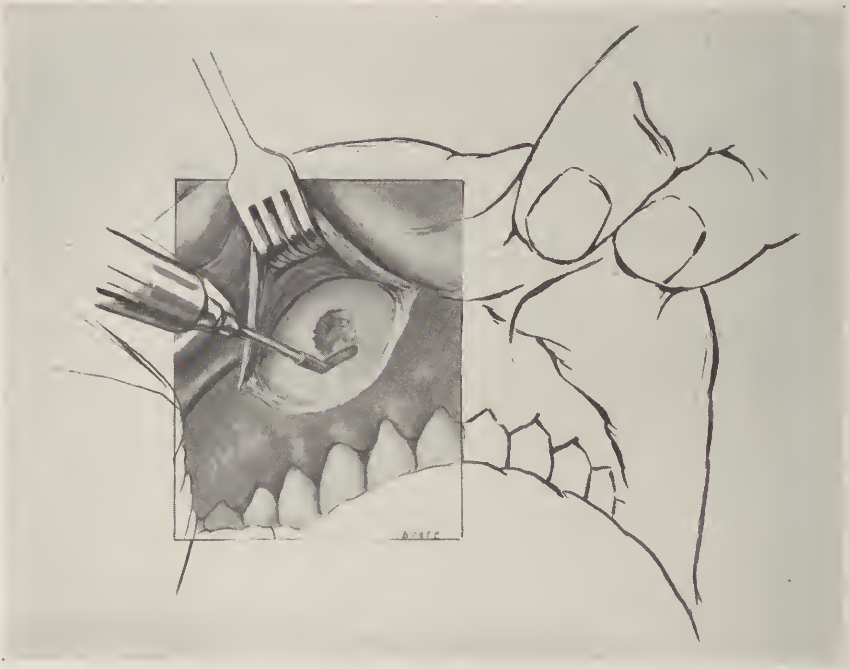


FIG. 37. The root divided by means of a fissure bur.

after treatment. The incision should be made just large enough to permit of clearly exposing the root to be operated upon.

It is important that we should have a good view of the root to avoid injuring the adjacent teeth or resecting the root end in a faulty way. In inaccessible locations, as in the case of posterior teeth, larger incisions will be necessary. Raise the mucoperiosteum next and expose the bone. (Fig. 35.) A sinus in, or a thinned out condition of the bone, or the alveolar ridge produced by the root of the tooth will usually guide us in determining the location of the apex. By means of a gouge or a chisel, the outer plate of bone is cut and lifted away, and the root exposed. Simultaneously, the pathological area will be disclosed to view, which, in the great majority of instances, will be found to be lined or filled with tissue proliferation. This may be a pericementoma, or a cystic condition and may or may not contain pus. (Fig. 36.)

At the point where the normal tissue attachments terminate, the root can be divided with a fissure bur (Fig. 37) and with a fine curette the entire pus sac or pericementoma may be lifted out from its bony crypt.

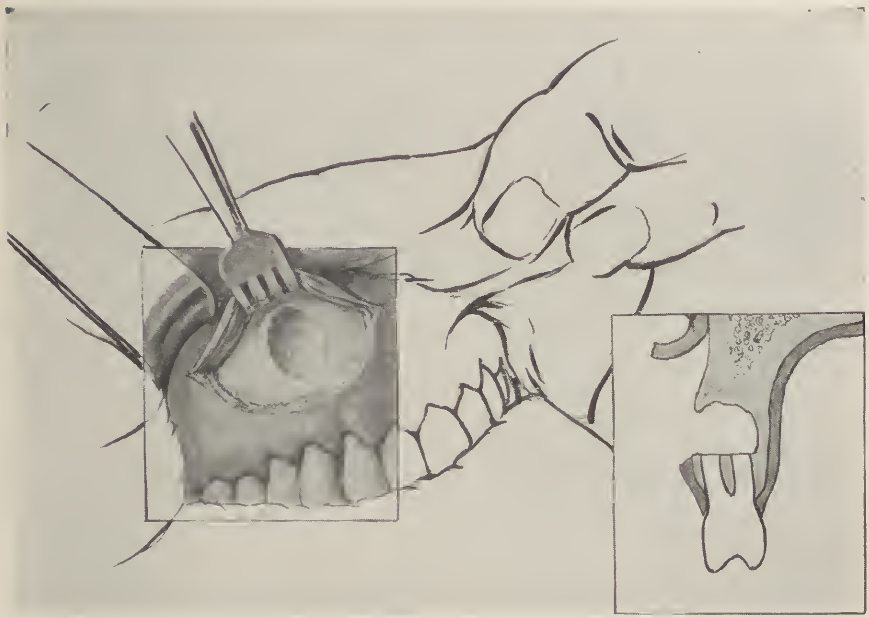


FIG. 38. The root end and the pathological area cleared.
FIG. 39. Diagram showing the relationship of the tissues.

The bone beyond this tissue is, as a rule, intact, shows signs of condensation osteitis and presents almost a burnished surface. While it is desirable that all of the contents of the cavity be removed, the curetting away of bone structures beyond this is not indicated. (Fig. 38.)

Some operators prefer to remove the portion of root to be amputated, with a sharp blow of a mallet and chisel. This is a somewhat risky procedure. A blow which is forceful enough to separate the root is likely to fracture the already weakened alveolus, or even dislodge the entire tooth. Besides, the root end cannot be divided with precision and will present a jagged surface which may become a source of irritation. Others base the success of this operation upon dividing the root within healthy tissues. In so doing, of necessity, some of the healthy and useful tissues will be sacrificed. While it is essential that all of the diseased tissues be removed, it is equally essential that all of the healthy tissues should be retained.

After all tissues thought necessary have been removed, the bone edges of the cavity are smoothed off and the mucoperiosteal flap returned to its former position.

The object of sutures is to approximate and keep in apposition the lips

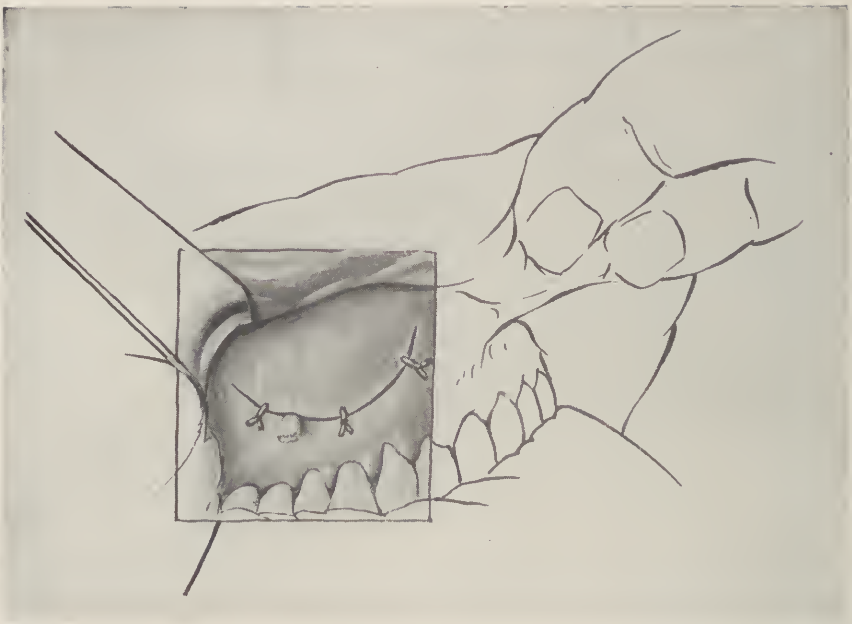


Fig. 40. The mucoperiosteum restored and sutured into position and dressing introduced without disturbing the coaptation.

of the wound. By so doing, we restore the normal contour of the parts and induce primary union between those parts of the severed tissues which are held in apposition. Where the incision is not too large and gaping, suturing may be omitted. Where the incision is made as illustrated by Fig. 34, and made just large enough for the amputation of an individual tooth, the resiliency of the tissues and the pressure of the lips, or the cheek, are quite sufficient to retain the mucoperiosteal flap in its normal relationship. Where suturing is resorted to, the suture should be introduced at the farthest point possible from the gingival margin and care should be taken that these parts be not injured. Silk, horse-hair, or catgut may be used for the purpose. (Fig. 40.)

Where the abscess cavity is small, and the vitality of the patient is normal, cicatrization will very readily follow and few or no dressings will be necessary. But even in these cases it is advisable to keep the patient under observation for at least ten days or two weeks, and to keep the wound irrigated with a mild antiseptic solution. Where the wound is fairly large and age or the vital resistance of the patient does not warrant such procedure, the cavity should be dressed with iodoform gauze, which may

be changed first every twenty-four, and later every forty-eight hours. The dressing should be lodged within the cavity. The exposed bone surfaces of the cavity will soon be covered by cicatricial tissue; it gradually diminishes in size and eventually becomes obliterated. If we are to trust

FIG. 41. A case of root end amputation before and after treatment.

FIG. 42. A case of root end amputation before and after treatment.

our radiographic records, a great part of this new tissue undergoes ossification.

To substantiate this claim, I submit two of many case histories which will be more illuminating than haphazard statements or the most eloquent arguments. The clinical presentation, the radiographic examination and the general health of these patients assure me that these conditions may justly be regarded as cured.

The ages of these patients are given at the time of the operation.

Case 1. Miss I. L. Age 20. The original radiograph of this case was lost. The upper lateral incisor had become abscessed as a result of caries. This case was treated in associa-

tion with Dr. R. Ottolengui for research purposes. At the time of root amputation a pericementoma was found to be present. Figure 41A was taken within a month after the operation was performed on May 22, 1917. Figure 41B was taken April 20, 1921—four years later.

Case 2. Miss M. N. Age 18. The pivoted right central incisor was amputated in March, 1912, and shows complete normal bone surrounding the entire tooth after ten years. (Fig. 42A.) The left central incisor shows a root canal filling and pathological

Fig. 43. Fig. 44. Fig. 45.

Fig. 43. Shows the condition about a root immediately after implantation.
Fig. 44. Shows considerable absorption of the root as early as five months later.
Fig. 45. Shows rapid progress of the absorption of the root three weeks later than the last illustration.

area. This was amputated on June 15, 1921. Figure 42B shows the condition five and a half months later, taken on December 6, 1921.

Possible Retention of Pulpless Teeth. To further supplement the stand that a pulpless or devitalized tooth is not a foreign nor a dead body the following case might be considered.

Patient J. H. Age 9 years. He fell on the street and had his upper left central incisor knocked out, also fracturing the mesial tip of the right central. The patient was seen five or six hours after the accident. The tooth was immediately placed into Ringer solution, the socket was cleaned, treated with antiseptic and packed with iodoform gauze. The tooth was opened under sterile precautions, the pulp was removed and the root canal was filled with chloropercha and gutta-percha. The next day the tooth socket was thoroughly irrigated with a warm saline solution and the tooth, which had been kept meanwhile in Ringer solution, was replanted. A splint was cemented in place October 28, 1922. (Fig. 43.)

The tooth was quite firm two months later when the splint was removed and the surrounding tissues appeared to be entirely normal.

Fig. 44 was taken March 15, 1923, and Fig. 45 on April 6. These radiographs show rapid and progressive absorption of the root. This replanted tooth evidently was accounted a foreign body, and we note Nature's osteoclastic processes in getting rid of it. Such summary destruction and exfoliation are never seen in connection with pulpless teeth.

CHAPTER VII.

Sublingual Abscesses.

Abscesses in the sublingual region present distinct characteristics which make their special consideration and description desirable.

Sublingual abscesses may occur at any point between the median line and the pillars of the fauces; they often present more severe complications than those which point towards the buccal aspect, or into the submaxillary region. Rise of temperature, general malaise and constitutional toxic symptoms are, as a rule, more pronounced than in other abscesses about the teeth and jaws.

Infection and abscesses in the sublingual region often occur as a result of comparatively slight injury of the mucosa; irritation and subsequent infection of the submaxillary, or sublingual salivary glands; injury and infection of these structures, or obstruction of a duct caused by salivary calculus, often lead to suppuration. They occur more commonly, however, as a result of the spreading of infection from an abscessed tooth; sepsis following operations, such as the removal of teeth; sloughing of the tissues resulting from severe laceration; traumatization; mangling and fragmentation of the bone and necrosis; excessive sloughing and infection of the soft tissues due to the toxic action of a local anesthetic; septic injection of a local anesthetic or injecting into a septic area.

Abscesses from Septic Injections.

The more severe and complicated abscesses in this region could almost invariably be traced to the injection of a septic local anesthetic. In these the following clinical symptoms are observed, and they run a fairly uniform course: The patient gives a history of having had a troublesome (not necessarily infected) tooth removed three or four days previously. The tooth is removed successfully, and there are no untoward complications for the first two or three days. On or about the third or fourth day a sense of discomfort begins to develop at the base of the tongue; there is a slight amount of pain and the temperature rises to about 99-100° F. Twenty-four or forty-eight hours later the pain becomes more troublesome, the swelling becomes larger and is now perceptible on the external surface of the submaxillary region as a deep-seated swelling. The mucosa underneath the tongue may be but slightly or considerably displaced

and may or may not be discolored. Upon palpation the tissues feel tense and deeply indurated. The epidermis and the underlying tissues in the submaxillary region present no signs of direct involvement, and upon palpation a deep-seated swelling between the oral mucosa and the hyoid muscles may be discerned. The infection often spreads into the deeper parts at the base of the tongue, or to the pillars of the fauces; the soft palate may become involved to such an extent that a complete half of the oropharynx is obstructed, simulating a peritonsillar abscess. The pain is now intense and radiating to the ear, to the temporal and cervical region, or the entire side of the head becomes sore and painful. The temperature may rise to 102-103° F.; reglutition and the movement of the tongue are difficult and painful, and there is a variable degree of trismus.

In the anterior part of the mouth, these abscesses are, as a rule, not quite so diffused; they are not so painful and are somewhat more easily controlled than those occurring more posteriorly. The infection does not tend to diffuse so readily here as in the posterior parts. All the tissues lodged underneath the anterior part of the tongue become considerably discolored and swollen to such an extent that the tongue becomes displaced and the swollen tissues appear fringed and ulcerated along the edges where they rest against the teeth.

Treatment. As in the treatment of all abscesses, evacuation and thorough drainage are important. This can be secured almost invariably intra-orally. External incision in the treatment of these cases is rarely essential. The span of the geniohyoglossus, the geniohyoid and the hyoglossus muscles serve as a barrier to the penetration of the pus to the external surface.

The displacement of the tissues is not to be taken as the sole guide in making the incision. The incision should always be close to the bone and as close to the floor of the mouth as possible, to secure a more ready point of drainage.

The mucosa having been incised and the opening enlarged to the desired size, a pair of blunt scissors are inserted and gradually insinuated into the deeper regions until pus is reached. Iodoform gauze is introduced to secure drainage and ice packs are applied on the external surface over the submaxillary region.

These abscesses are often mistaken for Ludwig's angina, or, when occurring in the anterior part of the mouth, for a ranula. In differential diagnosis, the clinical history is of distinct aid. A ranula can easily be differentiated from the abscess by the history, the inflammatory symptoms, the appearance of the tissues and by the general condition of the patient. (See "Ranula.")

CHAPTER VIII.

Surgical Treatment of Periodontoclasia.

The treatment of diseases of the investing tissues of the teeth, known under the collective term of "pyorrhea alveolaris," or more lately as "periodontoclasia," is a specialized field. By far the greatest number of these conditions can be successfully treated by means of prophylactic measures and so-called "root surgery." This comprises, mainly, the removal of all gingival and subgingival irritating factors, and also broken down and infected tissues, through the gingival opening created by the disease. Considerable importance is assigned, in this treatment, to the correction of traumatic occlusion, where this exists. It is not the author's intention, therefore, to enter here into a complete consideration of the subject, but rather to treat upon those types of conditions only, where these efforts in themselves are inadequate. To control all of the pathological phases presented and to secure better results, these measures must be supplemented with a degree of true surgical interference.

Surgery in Periodontoclasia.

It is not always a simple matter to determine just where surgical measures are indicated and where the more conservative means will be sufficiently effective. It may be stated that surgical interference should never be preferred and should be employed only where the nature of the pathological conditions permits of no alternative. In this we must be guided by close clinical examination and by thorough radiographic study, the exposures being made at different angles to disclose as accurately as possible the state of the investing tissues. Ofttimes the response to previous treatment may be the guide. The radiographs are not always reliable. They often represent the lesions as hopeless for any kind of conservative treatment in opposition to our clinical experience. Also, because of the angle at which the exposure is made, some lesions may not be well defined.

Etiology of Periodontoclasia.

Despite the intense study and close investigation which these diseases have been subjected to, through many years, the etiology is still obscure in many respects. It is fairly generally conceded, however, that, in numerous instances, the disease is caused by purely local agencies and that in others, both local and constitutional factors are present.

The local etiologic factors are always some forms of irritation, of traumatic or septic nature, or both. Of these the more frequent ones are salivary or serumal calcific deposits; traumatic occlusion of the teeth; ill-fitting restorations in the way of fillings, inlays, crowns, bridges and partial dentures.

Chronic traumatic irritation is always attended by some degree of inflammation of the gingival tissues, thereby rendering these points vulnerable to the invasion of the microörganisms present. Hartzell believes that when this occurs the streptococcus forms the van of the bacterial invasion, causing deterioration of the tissues, which is followed by the staphylococcus and the host of other organisms which infest the oral cavity.

Fig. 46. Hypertrophy of the gums and periodontoclasia in which surgical interference is indicated.

The systemic conditions act more often as predisposing factors in the causation of the disease. Systemic disorders, which tend to lower the vital resistance of the patient, are often found to be associated with the disease. All debilitating diseases, therefore, such as syphilis, tuberculosis, diabetes,

anemia and gastro-intestinal disorders may be regarded as predisposing factors. That nutrition and diet play an important part in the maintenance of the condition of the teeth and their investing tissues is amply proven by scurvy, for example. Our knowledge regarding the influence which

FIG. 47. A drawing after a clinical case. Note the marked recession and thickened condition of the gingivæ.

diet has upon diseases of the teeth and their investing tissues has been greatly augmented by researches of McCollum, Howe and others. On the other hand, we are often impressed with the fact that in some individuals, who are apparently in the best of health, presenting no symptoms of systemic disorders and whose mouths are kept scrupulously clean, with their occlusion normal, periodontoclasia nevertheless exists. Unquestionably senile atrophy, or sometimes precocious senile changes, play an important part in these cases.

Conditions Where Surgical Interference Is Indicated.

From a clinical standpoint, we may classify the cases in which surgical interference may be indicated into two general groups. One group is characterized by more or less extensive atrophy of the affected tissues. The second group is marked by hypertrophy, which is accompanied by a degree of breaking down and deterioration of the affected tissues.

It may be here stated that success in the treatment of these conditions is always dependent, in the largest measure, upon thorough prophylaxis

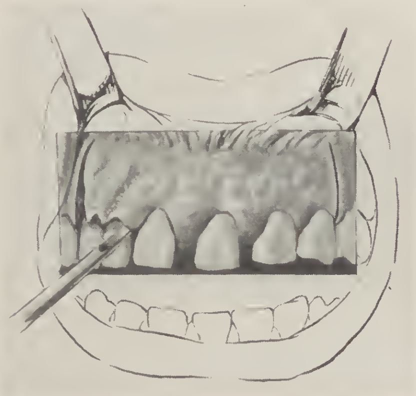


Fig. 48. The first step in the operation. Note the vertical incisions and the separation of the gingival tissues.

and the removal, correction and treatment of conditions recognized as local or systemic etiologic factors. Before undertaking any operative measures, therefore, the mouth in general should be scrupulously cleaned and the teeth freed from surface or subgingival deposits and then well polished. Considerable attention must be given to the elimination or correction of all systemic dyscrasia which may exist in the patient.

As intimated, in the first group may be classed all those conditions in which there is extensive pathological destruction of the pericementum and a proportionate infection of the cementum, and infection and breaking down of the alveolar process. As a result, deep pockets are formed about the affected tooth or teeth, in which any one surface, or all surfaces, may be involved. There may be frank, copious pus discharge upon pressure, or the pus may be so sparse that its presence cannot be clinically demonstrated. Black found that even in the absence of frank pus, pus cells were always present upon microscopic examination. When suppura-

tion exists, the pus discharged can often be eliminated, or checked with thorough prophylactic measures; scaling of the roots, in which all salivary and serumal deposits, infected portions of cementum, degenerated, or broken down, or infected pericementum and alveolar process are removed. Other etiologic factors, such as traumatic occlusion, or mechanical irritants must also be removed or corrected.

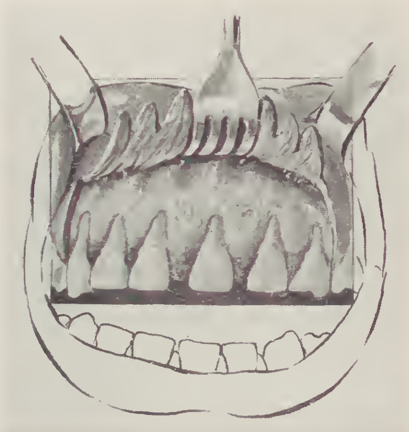


Fig. 49. Shows the gum flap raised and the low grade of granulations filling the interdental spaces exposed; also the denuded root surfaces.

This treatment is often followed by a complete cessation of the pus discharge, or it may be only decreased. Invariably, however, there is a general clinical improvement of the affected tissues, a degree of tightening of the teeth when these are loose, and a closer adherence between the tooth root and the investing tissues. While this may be encouraging from a clinical standpoint, the deep pockets extending to the middle portion of the root, or sometimes beyond that, cannot become completely obliterated. The physiological coördination cannot be reëstablished where, in the pathological process, a considerable part of the pericementum becomes destroyed and the cementum and the alveolar process become infected and broken down. The remaining pockets, therefore, predispose towards recurrence of the disease. These deep, infected pockets are also prone to act as foci of infection.

The object of a surgical operation, in these cases, is to reduce, or entirely excise these tissues which form the pockets. The operation is not new and was advocated and practiced originally by Riggs. It consists of the removal of that part of the gingival and gum tissues which form the

pocket, and cover the denuded root surfaces. In doing this, care must be exercised to retain as much of the gum tissues as possible. The operation leaves an unesthetic and very uncomfortable condition, so that, in my opinion, where this operation would need to be very extensive, the teeth should best be removed. Where a few isolated teeth are involved, the operation can be carried out with success and much satisfaction.

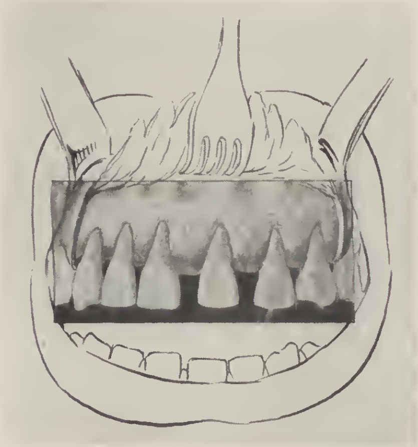


Fig. 50. The unhealthy granulations, infected and sharp portions of the alveolar process removed, and all surfaces smoothed.

The second group is characterized by hypertrophy of the gingival tissues. Fig. 46 is the case of a young woman 26 years of age. Note the blunted and irregular outline of the gum margins. The pockets are rather formed by the hypertrophied tissues than by destruction of the pericementum and alveolar process.

The pockets in these cases are not, as a rule, quite so deep, and much of the involved tissues is damaged to such an extent only that repair is quite possible. The gingival tissues are discolored; they have a great tendency to bleed; they may be somewhat ulcerated and there is, as a rule, a degree of suppuration. There are other cases in which exuberant sickly granulations fill the pockets formed and the interproximal spaces, thus filling in the points where the normal tissues have been destroyed. (Fig. 47.) There are still others, where the hypertrophied tissues cover a large part of the crown of the tooth. This last condition is more often observed in females than in males. It is quite frequent in women, during the period of pregnancy and lactation. Under the last stated circumstances operative

measures are decidedly contraindicated, as it will often be observed that at the cessation of this period, with the aid of prophylaxis, the tissues tend to return to normal.

The object of an operation, in these cases, is to remove the excess of tissues and also all those sickly non-viable granulations which cover the under surface of the gingiva and fill the interproximal and alveolar spaces.

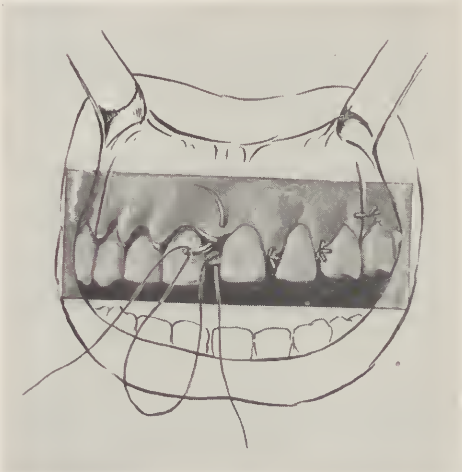


Fig. 51. The gum margins trimmed and the flaps sutured into place.

These tissues have a very low vitality and are subject to constant breaking down and infection and thus prevent healthy granulation. The operation suggested by Rubitzeck, and later modified by others, is well adapted to these cases.

Where a larger number of teeth are involved, the case should be handled in several operations, four or five teeth being treated at one time. Severe reaction may follow in individuals whose vital resistance is below par, because of some constitutional, debilitating complication. The danger of excessive reaction is not caused by the removal of sepsis but rather by the opening up of larger surfaces for the absorption of the sepsis and toxins which are ever present in these regions.

Technique of Operation.

Two vertical incisions are made, parallel with the long axis of the tooth and so directed that they terminate in the interdental spaces, distal to the teeth to be operated upon. (Fig. 48.) The tissues are next reflected somewhat beyond the point of pathological detachment. In this way the operative field is clearly exposed to view. (Fig. 49.) It is often found that sickly

granulations cover the everted surface of the gums and they also fill the interdental spaces and frequently penetrate into the necrotic, semi-absorbed and deteriorated alveolar process. With fine curettes and scalers these tissues are carefully removed. Necrosed portions and sharp edges of the alveolar process are carefully scraped away. (Fig. 50.) Note next, where the healthy tissues terminate, and the gums are trimmed in accordance with their prospective reattachment. Considerable care must be exercised in this, as neither the removal of good tissues, nor the formation of pockets, is desirable. The tissues on the lingual aspect are not resected to the same extent, but they are raised sufficiently to expose the area of operation. Note where the denuded dentinal surface terminates and trim the gums in such a manner that when the flap is returned, it reaches slightly beyond this point.

Both the lingual and labial or buccal flaps are brought into as close apposition as the intervention of the teeth permits. They are sutured through the interproximal spaces so that the gums rest snugly about the roots of the teeth. (Fig. 51.)

When the flaps are closely approximated in this manner, packing is superfluous. The aim should be to insure primary union wherever this is possible, thus reducing the amount of cicatricial tissue. That this is desirable is obvious, as granulation tissues, because of their lower vital resistance, offer a vulnerable point and they are more prone to break down, thus presenting a fertile field for bacterial invasion and recrudescence of the disease.

The postoperative treatment consists chiefly of thorough prophylactic measures and the sutures may be removed in four or five days. The gum margins appear highly inflamed at first, but these raw edges soon become covered with epithelium and, with cicatrization, a close adherence to the tooth surface is established.

CHAPTER IX.

Necrosis.

Necrosis is death of tissue. In this chapter we shall use this term to mean death of bone *en masse*. Necrosis in this sense is analogous to gangrene of the soft tissues and is to be distinguished from other forms of bone destruction, such as caries or suppurating osteitis. In these latter conditions the bone is destroyed by a progressive unlimited cellular disintegration, while in necrosis a portion of bone undergoes death in the aggregate without complete demolition of its inorganic matrix. In caries or in suppurating osteitis, the pathological process operates by extension from a primary focus (Fig. 52); in necrosis the death of a portion of bone is brought about rather by circulatory disturbances or the action of toxic substances. The former conditions must be regarded therefore as diseases, while the latter may truly be looked upon merely as a condition resulting from an injury or a disease.

Etiology of Necrosis of the Jaws.

(1) Infections originating in dental lesions, such as alveolar abscesses, purulent percementitis or pyorrhea alveolaris.

(2) Systemic infections, such as syphilis, tuberculosis, scarlet and typhoid fevers, or any other disease which tends to undermine the vital resistance of the patient.

(3) Inorganic poisons and drugs may act either by local application or by systemic absorption; as phosphorus, arsenic, mercury, hydrogen peroxid.

(4) Traumatic injuries.

(5) Sepsis introduced in local anesthesia in the solution or with the syringe or injecting it into a septic field.

Necrosis of the jaws is usually preceded by osteitis, i.e., inflammation of the bone itself, osteoperiostitis and at times by osteomyelitis. The lesion may originate, however, at the mucoperiosteum and involve the bone subsequently. In the presence of infection which, we will presume, has originated with a diseased tooth, the inflammatory process spreads until a considerable area of the bone becomes involved. The circulation within the Haversian system may become impaired, or entirely obstructed

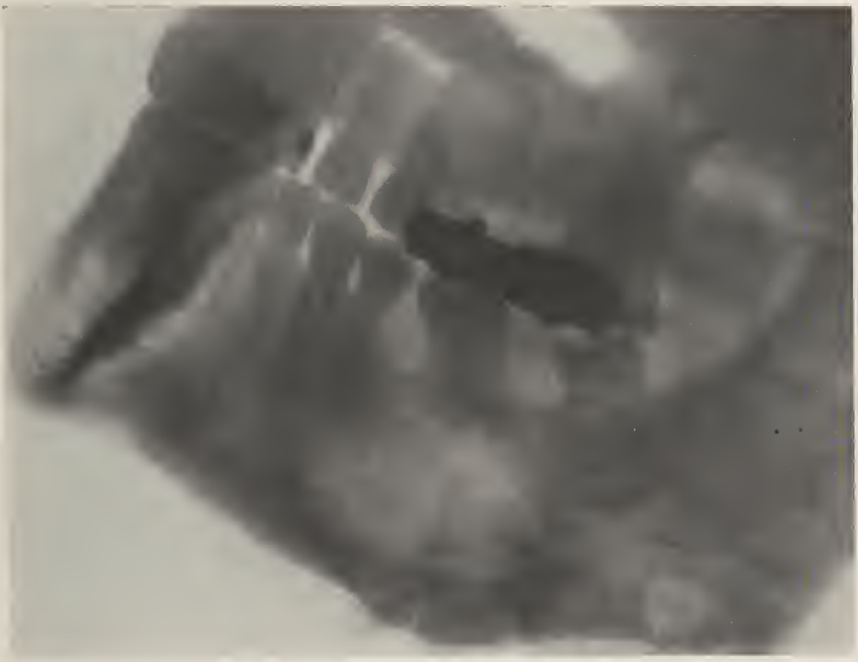


FIG. 52. Chronic suppurative osteitis in a man 28 years of age. The infection followed a traumatic injury although there was no fracture. Wassermann test was negative and there were no symptoms of tuberculosis. Note the diffused bone destruction and the subperiosteal enlargement of the bone at the point of lesion. Radiograph was taken when he was first seen, two months after the injury was sustained.

by the pressure of the inflammatory exudates. The occlusion of the blood vessels may also be caused by bacterial thrombi, or emboli, or they may be severed by a direct traumatic injury. When the mucoperiosteum becomes involved, the inflammatory exudates may collect underneath this tissue, and when it becomes separated from the bone, the second available channel of nutriment to the bone is cut off.

It may here be stated that if the source of sepsis were removed promptly and the tension relieved by incising the mucoperiosteum to the bone and drainage were thus established, numerous cases of extensive necrosis could be aborted at this stage. In the shafts of long bones an inflammatory condition and infection often extends through the epiphysis to the medullary canal and the endosteum and true osteomyelitis develops. In the jaws, as they have no medullary canal, either one of the two first

FIG. 53. Necrosis of the mandible, following infection of temporary molar, in child 7 years of age. There was a pathological fracture through the angle of the jaw. A part of the ramus and coronoid process became necrotic and the sequestrum can be seen anterior to and above the partly formed second molar.

conditions may obtain, or both may exist simultaneously. Such fine lines of demarcation are merely hypothetical, however, and they cannot be determined nor demonstrated clinically, for, even under the microscope, dead cells appear for some time very much like the living ones.

Sequestrum. Briefly, then, a portion of bone in which the vascular mechanism has been impaired or entirely obstructed, may die because of lack of nutrition. A portion of dead bone, whether it is deprived of its nutrition by traumatic injury, a surgical operation, or an inflammatory process inaugurated by an infection, is called a sequestrum. A sequestrum, lodged within vital surroundings, acts as an infected foreign body and is not tolerated by the surrounding healthy tissue. With necrotization, a reaction takes place in which there is a softening of the adjacent healthy bone and a line of demarcation by granulation tissue is formed. The tendency is to dislodge the sequestrum, and this process is called "exfoliation."

FIG. 54. Necrosis of the mandible in a child 7 years of age. The radiograph of the case is shown in Fig. 53. The necrosis followed infection and abscess of a temporary molar. In cases of this type after drainage is established and maintained for some time, the swelling, although marked, is free from all other inflammatory symptoms. Upon retention of pus the symptoms become fulminating. These swellings often persist for years or even permanently after the condition has been cured.

FIG. 55. Extensive necrosis in a boy 11 years of age, following the removal of abscessed permanent first molar. Here the entire ramus and part of the body were lost. The case was treated conservatively and while the necrosed parts were being exfoliated new bone formed. Note the fracture anterior to the angle and the separation of the condyloid process which was later removed. The ramus is newly formed bone.

Fig. 56. Necrosis of the ramus and part of the mandible in a boy 11 years of age. The radiograph of the case is shown in Fig. 55. The ramus seen in the radiograph is newly formed bone. The condyle is in a state of exfoliation and was removed later. In cases of this nature, there is a tendency of displacement of the jaw, because of lack of posterior support and the traction of the muscles which have lost their proper attachment. It is advisable therefore to provide an appliance to counteract this tendency and to correct the acquired deformity where this is present. The position of the chin suggests the degree of displacement.

Exfoliation. Exfoliation is usually accompanied by suppuration. There is a circumferential breaking down by osteoclasts and liquefaction of the sequestrum itself. When of long standing this presents, upon removal, an irregular, corroded, worm-eaten surface. Simultaneously, there occurs a receding absorption of the healthy bone beyond the granulation zone. This continues until the sequestrum becomes quite loose and can readily be removed. If it is not removed, suppuration will continue until the sequestrum is entirely broken down and liquefied or is extruded by the granulation process. This is true whether the sequestrum is a spicule or a larger section of bone.

Occurrence of Necrosis. Inflammatory conditions of the bone, following dental infections, are quite common. Extensive necrosis occurs more frequently in the lower than in the upper jaw. These conditions are more prone to develop in children, prior to the eruption of the permanent teeth. It should be remembered that at this period of life both the upper and lower jaws are more readily invaded by infection because of the physiological absorption and rarefied condition of the cancellous bone which attends the formation and the eruption of the permanent teeth. Infection under these circumstances tends to spread more readily and the results are often deplorable and disastrous. This is particularly true of children who are ill-nourished or whose vital resistance has been undermined by the exanthematous diseases. Too much stress cannot be laid, therefore, upon the need for the very prompt and careful attention that must be exercised in the presence of infection in young subjects. In adults, all nutritional abnormalities or diseases, such as anemia, pernicious anemia, diabetes, syphilis and tuberculosis, may be looked upon as predisposing causes. The necrotic area is usually confined to the affected side, though a number of cases have come under my observation, wherein both sides of the jaws became involved. This is more frequently true of the mandible. (See Figs. 53, 54, 55 and 56.)

Symptoms of Necrosis. Necrosis may follow almost spontaneously, an acute inflammation caused by any of the conditions described above. When this occurs, the area becomes largely swollen, with a deep throbbing pain and systemic symptoms of an acute infection. The bone itself becomes swollen, tender to the touch and when suppuration ensues the pus tends to point towards the external surfaces. The bone enlargement often produces a marked asymmetry of the facial outlines which may become corrected in the course of time by resorption. It is also to be noted that, in young children particularly, an increase in the overlying soft tissues occurs. This is quite marked in some. The

FIG. 57. Asymmetry in facial outline following extensive necrosis of the body and part of the ramus of the right side of the mandible. This condition existed three years after the case was dismissed as cured. There were no signs whatever to indicate the presence of a pathological condition at this time.

Fig. 58. Asymmetry of the mandible following necrosis of a section of the body of the bone in a woman 32 years of age. Necrosis followed the removal of a carious tooth. A cocain solution was used as the anesthetic and it was then suspected that the drug had something to do with the developing of necrosis. The photograph was taken six months after the case was cured.

FIG. 59. Bilateral necrosis of the body of the lower jaw in a girl 14 years of age. The condition began with abscess of the right first molar, and necrosis extended to the molar region of the opposite side. All of the other teeth were in perfect condition but they were practically exfoliated with the necrosed bone. Note how the mucoperiosteum separated from the necrotic bone.

FIG. 60. Same case as Fig. 59. Note the diffused ramifications of the necrosis through the entire body of the bone. This was taken soon after the onset of the infection. While the body of the bone was rebuilt the teeth and the alveolar process were lost.

Fig. 61. Same case as Figs. 59-60, showing a thickening of the entire mandible. The photograph was taken sixteen months after cicatrization and dismissal of the patient.

swelling is entirely free from all inflammatory conditions, is not painful and there is no impaired function. (Fig. 57.)

Where the enlargement is due to proliferative osteitis and hypertrophy of the bone, the deformity may be a permanent one. (Figs. 58, 59, 60 and 61.)

The pain caused by the inflammatory congestion can be relieved by a deep intra- or extra-oral incision carried through the overlying soft tissues to the bone. In the presence of suppuration, drainage and evacuation of the pus will promptly reduce all disturbing symptoms. If thorough drainage is maintained, the condition often passes into a chronic state, and suppuration continues until all of the sequestrum is removed.

Circumscribed and Diffuse Types of Necrosis

From a clinical standpoint we may differentiate two types of necrosis, i.e., the circumscribed and the diffuse. The circumscribed type is often preceded by an inflammatory and suppurative condition which passes into a chronic state, or has a tendency to chronicity. The diffuse type more often is the spontaneous result of a severe infection and acute inflammatory condition, which may nevertheless pass into a chronic state.

Circumscribed Necrosis.

The radiograph presents variable pictures, depending upon the nature of the necrosis. The circumscribed type appears as a portion of osseous tissue, definitely outlined by the surrounding granulation zone. (See Fig. 62.) In the diffuse type, the involved region or the entire thickness of the bone presents permeation of necrotic destruction with irregular ramifications. (Figs. 63, 64, 65, 66 and 67.) There are cases in which larger segments, involving a complete portion of bone, may become necrosed. A noteworthy case of this kind is presented in Fig. 68. This occurred in a girl 18 years of age. She had an upper molar removed, under local anesthesia, in which the tuberosity injection was used. Severe infection followed, and the pus eventually localized on the inner surface of the ramus. Free drainage was maintained intra-orally and later extra-orally, but the entire ramus became necrosed and was removed. It is well to point out here, that, in the presence of necrosis of this extent, or where even a smaller portion involving the complete thickness of the bone is lost, an appliance should be prepared to maintain the correct position of the parts and to prevent deformity after the sequestrum has been removed. In this, such a result was not anticipated as she had a good occlusion of the teeth. About fourteen days after the removal of the sequestrum the entire mandible was shifted backward and to the left side, creating a disparity of more than half an inch in the occlusion. An orthodontic appliance was made and the mandible was brought into place by means of rubber bands. (See more detailed description in Chapter X.)

Fig. 62. Circumscribed necrosis of the lower jaw in a man 31 years of age. This followed the removal of an infected third molar. All examinations and history negative. The radiograph shows the condition three months after the onset of the disease. Note the zone of liquefaction about the sequestrum and also the limiting condensing osteitis beyond the area of liquefaction.

Fig. 63. Unilateral diffuse necrosis of the lower jaw in a man 35 years of age. Note the isolated fragments of bone and the ramifications of the necrotic condition.

Figs. 64 and 65. Necrosis of the lower jaw in a young girl 16 years of age incidental to an abscessed lower first molar. This presents a typical picture of diffuse osteomyelitis, and necrosis. Note honeycombing of the bone by the necrotic process. The entire right side of the anterior portion to the bicuspid on the left side became involved.

Fig. 66. Necrosis of diffused type of the entire body of the mandible in a young man 23 years of age. All examinations, also Wassermann test, were negative. The condition started with an abscessed tooth bearing a bridge and soon spread to the opposite side. Note the honeycombed appearance of the entire bone. It is impossible to determine which portions of the bone are necrosed and which are living and to be retained. The case must be conservatively treated and Nature relied upon to do the exfoliation. Curetting would simply aggravate the condition and cause the loss, probably, of the entire mandible.

The presence of necrosis may be established best by means of the radiograph. Where this is not available, or where its interpretation is obscure, probing through the sinus is a diagnostic aid. Necrosed bone usually presents to the steel probe as a gritty rasping solid, and upon contact we obtain a sharp metallic note. Living bone feels more like a smooth, elastic surface, and gives no clear metallic note on contact.

Fig. 67. Spontaneous diffuse necrosis of the left side of the upper jaw in a woman 32 years of age. Abscess formed upon the carious first molar. The pus diffusion spread very rapidly and osteomyelitis and necrosis developed in four days after the initial onset of the disease. The radiograph was taken on the fourth day after the onset of the acute symptoms and shows involvement of all of the teeth on the affected side. Except the first molar, all the teeth within the region were normal and contained no cavities nor fillings. Though the case was treated very conservatively all of these teeth were lost.

Treatment of Necrosis.

The first step in the treatment is relieving by deep incision the inflammatory tension, evacuation of pus, and establishment of free drainage. Thorough drainage is imperative as this prevents the spreading of the infection and aids the exfoliation of the sequestrum. The statement that surgical interference should always be conservative cannot be over-emphasized. Despite the fact that some of these cases may be so prolonged as to become tiresome to both the surgeon and patient, a fine sense of discrimination must be exercised to determine the proper time for surgical steps to be taken and when this would be merely a meddlesome, aggravating procedure.

With radical curettement, or an attempt to dislodge the as yet unsep-

FIG. 68. Necrosis of the ramus due to sepsis following a tuberosity injection for the removal of an upper molar.

arated sequestrum, the osteogenetic tissues are often traumatized. Such aggressive procedure only tends to cause spreading of the infection, delayed repair of bone, and not infrequently an irreparable loss of large sections of bone and a permanent pathological fracture.

In the circumscribed type of necrosis, the separation of the sequestrum is disclosed by the radiograph. Upon probing, the necrotic bone feels loose and it may be held down merely by the overlapping tissues. At this stage it is permissible to expose this region thoroughly, and the sequestrum can be removed. The bed of the sequestrum is lined with granulation tissue, which, on the surface, is poorly organized, soggy with pus, and shows clinical signs of degeneration. It is good practice to remove this non-viable tissue, but injury to the deeper strata of granulations which are closely adherent to the healthy bone should be avoided. The postoperative treatment consists of irrigation and light dressing with iodoform gauze until cicatrization ensues.

Diffuse Necrosis.

The diffuse type of cases, as a rule, are more troublesome and often more protracted. In their treatment the underlying principles of prompt drainage and irrigation are equally important. In these we have a number of smaller and larger portions of necrotic bone undergoing exfoliation and the progress of this process must be carefully observed. The radiograph here is not quite so well defined and 'does not show the clear-cut line of demarcation between healthy and necrotic bone structure. The entire involved part seems to be traversed by irregular penetrating lines and channels. It is impossible to discern which strip of bone is healthy, or in a state of repair, and which is dead and in a state of exfoliation. Frequent probing and the persistence of suppuration are helpful in determining when and where a sequestrum has formed.

Suppuration will persist until all necrosed bone is removed or exfoliated. Continued suppuration is a decided sign of the presence of a sequestrum.

Prognosis in Cases of Necrosis.

Prognosis is usually favorable. Care must be given to the patient's general health. The vital resistance which is likely to be undermined by the lengthy suppurative condition, should be maintained with proper diet, careful elimination, rest and hygiene. The bone itself will repair and regenerate through the osteogenetic tissues. Often large hollowed-out regions will become spanned over and completely ossified. The new bone may be somewhat different in its structure from that which it replaces, but in accordance with Wolff's law of bone regeneration, it will, in the course of time, be restored in external form, and internal structure by its functional requirements.

CHAPTER X.

Infections and Complications Arising from Local Anesthesia.

The question is frequently asked whether there is danger in the administration of local anesthetics. This query may be directly answered by stating that there is no danger whatever in the careful and discriminate use of the mildly toxic local anesthetics, such as are obtainable at the present time.

To substantiate this statement we look back over a period of from ten to fifteen years, during which time many thousands of administrations have been performed without a single untoward complication, except some minor, transitory reactions, lasting but a few minutes. The statement cannot be made unqualifiedly, however, as we have had to treat cases of a serious and alarming nature on numerous occasions, and even fatalities have been reported which could be directly traced to a fault in some phase of the administration of the anesthetic. We must admit therefore that there is an element of danger in local anesthesia, if not properly performed.

Up to this time many thousands of cases have been operated upon successfully, for almost every condition which might be encountered in the practice of oral surgery, from the removal of a tooth to the removal of growths and even the correction of cleft palates in adult patients. The patients have not always been the best kind of risks, as much of this work was done at clinics, amongst patients whose general health, nutrition, vital resistance and personal hygiene were practically at the lowest ebb. Their ages ranged from 6 years to 80 and 85. Many of these were suffering from graver maladies, such as diabetes, anemia, arteriosclerosis, leucemia, or affections of some of the vital organs, such as the heart, the kidneys, the liver, etc.

It should be remembered that all anesthetics, even those of the least degree of toxicity, are protoplasmic poisons; that their toxicity, so far as local and general symptoms are concerned, is in direct ratio with the concentration; that a given quantity of the drug, in a more diluted solution, may be introduced without producing toxic symptoms, whereas the same dose in a more concentrated form may prove dangerous; that the injected

tissues enter more readily into a loose chemical combination with weaker solutions; that the anesthesia may not be quite so lasting, but it is just as profound and will endure long enough for all practical purposes; that the injected tissues, inundated with this foreign substance, recover much more readily from the effects when used in lesser concentration; that for this reason, conduction anesthesia is rarely followed by excessive sloughing of the tissues, such as we were wont to see when submucous injections of cocain were more generally used. The toxic action of the drug, superseded by the operative trauma, is often followed by necrosis of the soft and osseous tissues.

Causes of Complications in Local Anesthesia.

The above statement is made simply as a matter of general information and as a matter of record. It should be of interest therefore to find the causes of the complications which often attend the use of local anesthesia in some men's hands. Upon analyzing these, I find that the source of the trouble is not, as a rule, inherent in the case itself, but in almost every instance is traceable to some fault in the technique. Of these we may enumerate the following: (1) sepsis; (2) faulty solution; (3) faulty technique in the administration; (4) defective syringes or needles used.

Sepsis.

Sepsis is the source of the gravest complications and in some cases which have been brought to the writer's attention, even fatalities have resulted:

Sepsis may be introduced by three means: (1) septic syringes or needles; (2) the injection of a septic solution; (3) injecting into a septic area.

The first two are the more common sources of danger. This is particularly true in deep injections, such as the mandibular, tuberosity, or infra-orbital. The reactions caused are in some instances only very mild and may resolve; in others severe complications, such as deep-seated abscesses in the tonsillar, peritonsillar, sublingual, submaxillary, or temporal region may develop.

While there is a degree of parallelism so far as the symptoms and reaction are concerned in most cases, there are phases of variation which are most likely dependent upon: (1) the type and number of microörganisms introduced: (2) the general health and the vital resistance of the patient.

From my own observations I may state that more severe and more immediate reactions, both systemic and local, have followed where the injection was made into a septic area, than where extraneous sepsis is introduced. The injection necessarily produces a degree of tension of

the tissue and it is probable that through this pressure the microörganisms and their toxins are practically forced into the tissues and upon the system in overwhelming doses.

The reaction is marked by immediate aggravation of the local symptoms when this is present. The pain becomes more severe; the swelling becomes greater; the systemic symptoms also get to be more accentuated. In most cases there is a rise in temperature. There may be severe headaches, chills and fever, pains and aches all over the body, and a marked leucocytosis. Treatment of the local conditions does little in the way of relieving and often has no influence whatever upon the systemic symptoms. Some cases terminate fatally and in those which recover there are usually local conditions in the way of extensive necrosis of the soft as well as of the hard tissues.

Case History of Death from Sepsis.

The following history will illustrate a case of this type. Patient was a boy 12 years of age; applied at the clinic for treatment, reporting that three days before he had had a slight swelling on the left side of the upper molar region. He went to a dentist, who removed a carious and obviously abscessed temporary molar under local anesthesia. The face became considerably more swollen in a few hours after the removal of the tooth. He was now suffering excruciating pain and the physician found the temperature to be 102° F. Three days later he was admitted to the hospital. Upon examination, it was found that the pain had somewhat diminished; the cheek was considerably swollen; the mucoperiosteum in the region of the extracted tooth socket was badly discolored; a considerable area was completely necrosed, leaving the bone denuded, and the breath was almost unbearably fetid. All other teeth in this region appeared normal and the entire mouth was in a generally clean condition. The sloughing of the soft tissues showed a tendency of spreading, and very soon the osseous tissues, which became denuded at first, showed signs of necrosis, the bone spaces being saturated with pus and other substances of decomposition. There was marked cervical adenopathy and an exceedingly high leucocytosis. Despite all care and treatment, the patient died ten days after the removal of the tooth.

In observing a number of cases I have been impressed with the fact that where the septic agent was introduced into the deeper tissues with the syringe, or in the solution used, no immediate reaction occurred. The local as well as the systemic symptoms came into evidence only from five to eight days after the injection had been made. We may reason that this is probably the incubation period, during which the microörganisms change and multiply sufficiently to cause symptoms. To illustrate a condition in

which the deduction can reasonably be made that the septic substances have been introduced upon a septic needle, in the solution, or both, the following case history may prove of interest:

Sepsis Introduced on Needle or Otherwise.

Mr. M. B., age 27. Date of first consultation, December 12, 1921. Had his lower left third molar extracted fourteen days before this date. All data prior to this and family history negative. The tooth was simply carious and was removed under conduction anesthesia (mandibular injection). On the evening of the fourth day the face commenced to feel uncomfortable, and on the fifth day there was a degree of pain and slight difficulty in opening the mouth to the full extent. On the following day he returned to the oral surgeon, who washed out the tooth socket, and, as the radiographic examination was negative, stated that he could find nothing that should give him trouble. A sedative was prescribed, and the patient instructed to return if there was any further trouble. After two more days the face and the tissue on the inner surface of the ramus became swollen. He suffered intense pain, was unable to sleep, had general malaise, his temperature fluctuated between 101-103° F., and other signs of a severe infection presented.

Upon examination I found that the face was considerably swollen from the temporal region down to the lower border of the mandible. The submaxillary area was not invaded, the outer skin surface presented no signs of the localization of the infection, neither by way of discoloration nor by fluctuation. The patient was unable to open his mouth more than about a quarter of an inch, was unable to swallow and had the sensation of choking. The soft palate and the peritonsillar tissues were swollen to such an extent that half of the oropharynx was obstructed. The presence of pus was diagnosed immediately. A radiograph of the entire half of the jaw was taken and was negative; the parts from which the molar had been removed appeared decidedly normal and the tooth socket was practically closed. These two last points are rather significant in the case—the negative radiograph and the healthy normal state of the soft, as well as the osseous tissues in the region of the operation.

The patient was given 10 gr. of triple bromid, and under nitrous oxid-oxygen anesthesia, the swelling was freely incised through the peritonsillar region. A large quantity of very foul-smelling pus was evacuated. The collapsed tissue bag was irrigated and dressed with iodoform gauze. As in all cases of this nature, evacuation and drainage gave immediate relief. Later, examination revealed that the entire ramus was stripped of most of its soft tissue covering on all surfaces. Pressure opposite the temporal region would force down some of the pus confined there and for the

evacuation of the outer swelling an external incision had to be made just below the angle of the jaw, five days after the first operation.

The localization and evacuation of the pus and the maintenance of free drainage are of paramount importance in the treatment of all of these cases. For some time it was feared that the entire ramus might become necrosed as we could reach the bone with a blunt probe on every surface, indicating that the entire ramus was completely denuded. The patient made an uneventful recovery, however, and was dismissed on January 30, 1922.

A Case History of Necrosis. A case where extensive necrosis followed has been observed by the writer, and as this brings out a number of important points, the citation of the case may be of value.

Miss R., 19 years of age, was first seen by the writer on August 15, 1922. A carious upper first molar had been removed, under conduction anesthesia, nine days before this date. Tuberosity injection was used, and the tooth was successfully removed. Five days after the removal of the tooth the patient commenced to experience pain in the temporal region. Twenty-four hours later the pain became more intense, and a slight swelling appeared just above the zygomatic region. On the third day after the onset of the complaint the patient was suffering very intense pain, and her temperature fluctuated between 101-103° F. The attending physician prescribed coal tar sedatives, which were taken freely with but very little palliative effect. Upon examination, the patient was found to be quite exhausted from the prolonged fasting, sleeplessness and suffering. The skin was of a pale, grayish hue; the lips and the ear lobes appeared cyanotic from the large amount of the coal tar products taken.

Upon external examination I found that the swelling was practically confined to the temporal region, commencing at the zygomatic arch, covering the full extent of the temporal fossa. Upon palpation, a vague sense of deep fluctuation could be discerned. The patient could freely open her mouth, indicating that the ramus and the muscles of mastication were not in any way affected. The site from which the tooth had been removed appeared normal, there being no sign of laceration, discoloration or swelling in this region, and the tooth socket was fairly closed.

The patient was to have been removed to a hospital, but, as arrangements could not be made the same day, cold applications were prescribed and the sedative was changed. The patient was much more restful during the night and she slept a few hours. The next morning the swelling seemed to localize on the inner surface of the remus. The temporal swelling became smaller and less tender. The patient was taken to the hospital,

and, under ether anesthesia, an intra-oral incision was made into the sphenomaxillary fossa and the anterior pillars of the fauces, and free drainage secured. Despite the free drainage maintained, the entire ramus necrosed, as illustrated by the radiograph, Fig. 68.

Conclusions Regarding Sepsis. From these histories, the following conclusions may be made: That where an anesthetic solution is injected into a septic area, the local as well as the systemic reactions are more immediate and more severe; that there is a marked sloughing of the soft tissues and that necrosis of the osseous tissues may follow; that it is possible that, besides injecting into a septic area, sepsis may be introduced with the needle or in the solution or both; that while it may appear that conduction anesthesia is more dangerous than submucous injection, the contrary is true, provided that the injection is made carefully and aseptically; that the farther we inject from the area to be operated upon, the more the possibilities of infection are reduced; that the tissues operated upon recover more readily from the operative trauma if this is not superseded by the injection of an anesthetic, as, without exception, they are protoplasmic poisons, and it is only a question of degree.

Where the sepsis is introduced upon the needle or in the solution, the first signs of reaction appear from four to eight or nine days after the injection has been made. The first sign of trouble is impaired function; thus we observe in mandibular injections that a degree of trismus precedes all other symptoms; that the reaction is more severe in some individuals than in others, and that other symptoms, indicating the presence of a deep-seated infection, may also be present; that this condition is not to be confounded with the trismus which sometimes follows a mandibular injection, due probably to faulty technique, such as injecting into a muscle, the use of a hyper- or hypotonic solution, or postoperative trauma, as these forms of trismus occur almost immediately upon the wearing off of the anesthetic; that the tissues at the site of the operation usually show no signs of infection and seem to be doing well; that the radiograph is, as a rule, negative, as there is no alteration in the osseous tissues as yet, unless this has existed prior to the injection; that the prognosis in these cases is favorable, provided that timely, free evacuation is secured and thorough drainage maintained.

Faulty Solutions. As intimated before, sepsis in the solution is the most frequent cause for severe complications. Besides this, the admixture of some impurities may induce unexpected untoward reactions. Numerous cases of unduly prolonged anesthesia have been reported. This, in my estimation, is caused by the alcohol of the

Fig. 69.

Fig. 70.

Fig. 71.

Fig. 72.

Fig. 73.

Figs. 69, 70, 71, 72 and 73 illustrate the faulty positions in which needles are often inserted, indicating that poor technique has been used in these injections.

alcohol and glycerin solution in which the syringes and dissolving cups are kept. This may be prevented by submerging the syringes only to such an extent that the alcohol cannot gravitate into them. The small quantity which may pass up into the needle by capillary attraction can easily be removed with proper irrigation. The dissolving cups should be kept in the sterilizer, specially maintained with the anesthesia instrumentarium. Hyper- or hypotonic solutions are at times the cause of excessive post-injection pain; and, finally, high concentration or excessive dosage may cause local as well as systemic untoward complications.

It cannot be left unmentioned that cases have come to our attention where formalin, tincture of aconite, or bichlorid of mercury had been injected instead of the anesthetic solution. This can only occur when stock solution is used, and bottles are mixed. These accidents can be prevented by: (1) keeping the local anesthesia instrumentarium separate and apart; (2) having a special sterilizer for the sterilization of the dissolving cups and the syringes; (3) excluding alcohol and glycerin from the inside of the syringes; (4) preparing a fresh solution for each individual injection or for several injections performed in, say the same

Fig. 74. Lateral view of the mandible showing the anteroposterior position of the broken needle.

hour; (5) preparing an isotonic vehicle and not altering its chemical composition by too much boiling or by the admixture of extraneous substances.

Faulty Administration. This consists chiefly in not observing the osseous anatomical landmarks as guides in injections; injecting too rapidly, thereby causing excessive distension of the tissues and injury to the cells, or forcing a toxic dose upon the system.

Broken Needles. Since the more general use of conduction anesthesia, needles have been broken during injection and lost in the tissues. This occurs more frequently in mandibular than in infra-orbital or tuberosity injections. It can be emphatically stated that the accident can be ascribed to no approved technique practiced, but rather to faulty technique. The fault may be in the manipulation of the syringe, but it is more often due to defective needles. (Figs. 69, 70, 71, 72 and 73.)

Of the forty-odd cases of broken needles which have been brought to my attention, every one was a steel needle, and upon removal I have found some of them to be unmistakably rusty. Undoubtedly, the iridio-platinum needles do also break, but they are more flexible and have to be bent several times before they are actually broken apart. Because of the

Fig. 75. Radiograph taken through the head of the same case as Fig. 74, showing that the needle is on the inner surface of the mandible and that the anterior part of the needle is towards the tongue and the posterior part close to the bone.

greater tenacity of iridio-platinum, a certain amount of warning is offered to the operator and he can guard against this accident. The steel needles, however, snap very readily; and when compression of the tissues, with the guiding and palpating finger, is released, or when there is a sudden movement of the patient, the needle is lost.

It is impossible to state what the untoward results might be if one of these needles were left in the tissues, especially if it were sterile. I have seen no report, nor have I seen a case where complications resulted because of this. Still, it is rational to think that the needle will act as an irritating foreign body, and, whenever possible, it should be removed.

The first case which came to my attention was brought to me by a colleague, in 1914. I was unable then to find the description of a technique

for its removal, and my first instinct was to be entirely guided by the radiograph. This in itself I found to be misleading in many respects. Since then the following routine technique has been adopted in these

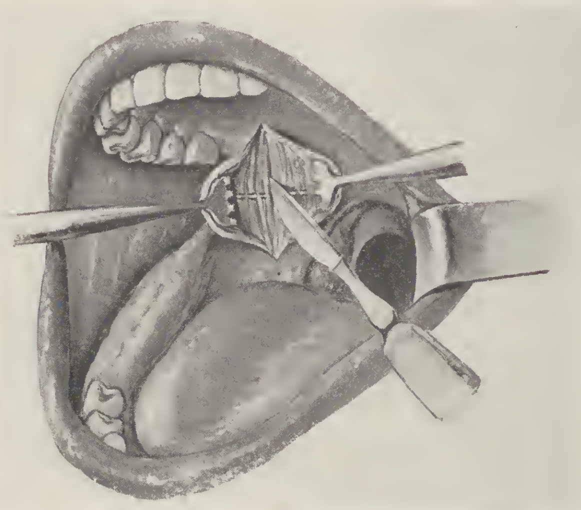


FIG. 76. Illustrates the line of incision to be made on the inner surface of the mandible. The soft tissues are carefully laid open until the needle is reached.

cases: Two radiographic plates are taken. One 5 by 7 in. lateral exposure, Fig. 74. This shows the anteroposterior position of the needle. The second plate, 8 by 10 in., is taken with an anteroposterior exposure, the same as for the examination of the maxillary sinus, Fig. 75. This will determine three important points: (1) the more accurate vertical position or relationship of the needle; (2) whether the needle is located on the outer or inner surface of the ramus of the mandible; (3) and this is very important, whether the needle is close to the bone or buried in the overlying soft tissues.

At first glance, it would seem that the removal of a needle so lost should offer no difficulties whatever. In practice, however, it is a rather irksome, tedious, and often lengthy operation. In the hands of the experienced, the removal of a needle may take anywhere from a few minutes to an hour, or even longer. I have recently seen the case of a young man, 26 years of age, who was taken to a local hospital in one of the smaller towns. The patient was operated upon for the removal of a needle, under ether, on three different occasions within a week or ten

days. In the first two operations, each lasting three hours, the removal of the needle was attempted intra-orally. In the third operation, an external incision, about three inches long, was made, and the entire cheek

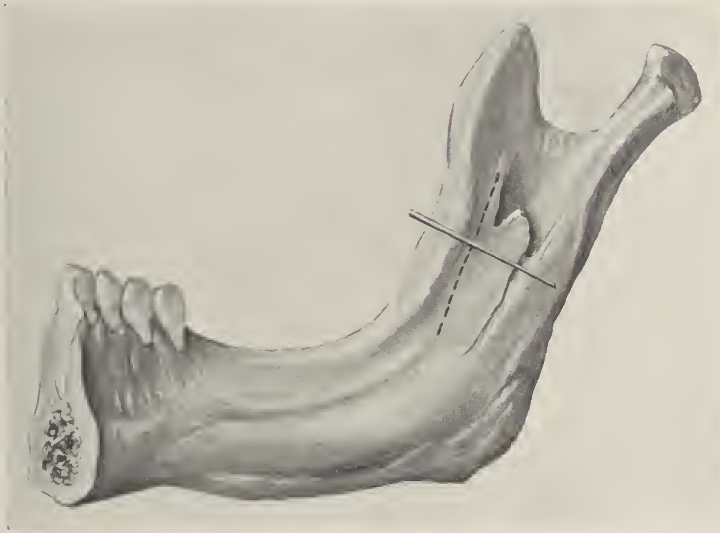


FIG. 77. Is a diagram of the relative position of the mandible and the broken needle.

was laid back. This operation lasted over three hours, and the needle was not found. External incisions here are entirely uncalled for as well as impractical and should never be contemplated nor permitted.

Operative Procedure for Removing Broken Needle.

The operation is best performed under local anesthesia, and intra-orally. In the presence of severe swelling with the tissues displaced and false ankylosis, it is well to wait a few days until these conditions subside, and when the parts have returned to a state of normalcy the operation can be performed with greater ease.

In studying the anatomical relationship of the parts we often find that a large part of the needle is anterior to the mandibular foramen. The only important structure which might be damaged at this point is the lingual nerve, and this is well below the surface of the needle, when it reaches a more anterior and superficial position. There are numerous muscle fibers of the soft palate and the pharynx, and of the muscles of mastication and their tendons. The glistening tendons are often misleading, as they have almost a metallic sheen. Most of the structures encoun-

FIG. 78. Lateral view of a needle broken in the tuberosity area representing it resting against the bone.

tered lie more or less in a vertical plane and at a right angle to the needle. Much palpation, in the hope of so discovering the needle, is of little avail, and only tends to displace it, or probably to force it more deeply into the tissues. The line of incision is made through the mucous membrane on the inner surface of the ramus and about a quarter or half an inch behind the anterior border of the bone. The tissues covering the inner surface of the bone are gradually incised and each layer retracted. (Figs. 76 and 77.) The hemorrhage is usually not very severe and is easily controlled. In this manner the deeper parts are penetrated until the needle is reached. The region is very obscure and a good headlight is very helpful.

A very fine, thin-bladed scalpel is used. The blade striking against

Fig. 79. Anteroposterior radiograph of the same case as Fig. 78, showing that the needle is quite a distance away from the bone.

the metal needle can be readily discerned. The tissues are retracted next at this depth and the needle may sometimes be disclosed to view. Very often, however, the operative field is obscured by the hemorrhage or the overlying tissues. In these instances we have to be dependent upon a fine and discerning touch for the localization of the needle. When this is definitely determined, the needle is grasped with a pair of artery or thumb forceps and gently pushed forward until it projects through the tissues and is removed. The retracted tissues are released next and the mucous membrane sutured. In the presence of hemorrhage, or where infection and suppuration are feared, the wound may be dressed with iodoform gauze between the sutures. A partial false ankylosis and considerable

swelling of the pharyngeal as well as the outer tissues may follow, which, however, gradually subsides in from one to two weeks. Suppuration rarely complicates the case.

Needles lost in tuberosity injections are not quite so frequent as those lost in mandibular injections and are recovered more easily, in my experience. Here, likewise, the radiograph is very important, but may prove quite misleading. An intra-oral film, obviously, represents the needle resting against the bone and the mucoperiosteum is simply stripped away, with the hope that the needle is imbedded between the periosteum and the bone. (Fig. 78.) This is found to be the case very frequently; but it is a surer plan to take at least two or three radiographs, one of which must be taken with an anteroposterior penetration through the head. (Fig. 79.) This will often show that the needle is about a quarter or half an inch away from the bone, buried in the soft tissues. The general plan for the removal is that followed in the mandibular area. Needles broken in submucous injections can be removed with facility in most instances.

Deductions. Regarding the breaking of needles, the following deductions and suggestions may be made: very fine needles may be introduced less painfully and with less injury to the penetrated tissues, but the danger of breakage is more imminent than when heavier needles are used. A not excessively heavy needle is quite permissible, and with proper technique, by injecting a slight amount ahead of the needle, causes very little pain; breakage of needles is just as often due to improper technique as to defective needles; do not attempt to penetrate the bone with the needle—it cannot be done; iridio-platinum needles are far safer than steel ones. These are more easily sterilized, as they can be flamed after every insertion into the tissues, and they do not break as easily as do the steel ones.

CHAPTER XI.

Diseases of the Maxillary Sinus of Oral Origin.

Anatomy of Maxillary Sinus.

The maxillary sinus, or the antrum of Highmore, is a cavity which occupies the body of the superior maxillary bone. It is roughly pyramidal in shape, its base being its medial or nasal wall, and its apex corresponding to the zygomatic process of the bone. It has five walls, a superior, an anterior, an outer, a posterior and a medial.

The superior wall is the orbital plate, a thin lamina of bone which separates the sinus from the orbital cavity above. This plate of bone is traversed by the infra-orbital nerve and vessels in the central portion of its inferior surface. These structures are lodged in a groove or canal and in many cases are in parts covered only by the lining membrane of the sinus. The anterior wall corresponds to the anterior surface of the maxillary bone; the outer wall to the malar process of the maxillary bone; the posterior wall corresponds to its infratemporal or zygomatic surface. The medial wall separates the sinus from the nasal cavity. This wall transmits the *ostium maxillare,* which is normally situated in its upper and anterior portion, and provides communication through the hiatus semilunaris, between the antrum and the middle meatus of the nose. This orifice is well above the floor of the cavity when the head is erect; therefore gravity does not assist drainage through this channel when in an upright position.

The lining membrane of the maxillary sinus is connected through the ostium maxillare and is continuous with the lining of the nasal cavity and the other accessory sinuses of the nose. This lining, the Schneiderian membrane, is a mucoperiosteum surmounted by ciliated columnar epithelium and may be absent in patches. Normally it is slightly moist. The ciliæ aid in cleansing the cavity by beating towards the osteum which is the normal channel of drainage.

The maxillary sinus is the largest of the air chambers accessory to the nasal cavity. It is comparatively smaller in youth, its walls being thick, accommodating the unerupted, developing teeth. It enlarges with age at the expense of its bony walls, so that in old age it is large, with compara-

tively thin walls. One or both sinuses may be congenitally absent, or malformed.

Infections of the Maxillary Sinus.

It has been stated by men whose assertions may be considered authoritative on the subject that 75 per cent of infections of the maxillary sinus are of dental origin. A more accurate judgment regarding this assertion could be obtained, if the data of the oral surgeons would be compared with those of the rhinologists. The treatment of diseases of the maxillary sinus of other than dental or oral origin, or those which are complicated with infections of some other of the accessory sinuses, belong to the province of the rhinologist and, despite the analogies and similarities which prevail in all cases, they shall not enter into our present consideration of the subject.

Whatever the exact truth may be, it is an established fact that the oral cavity is a frequent source of infection of this sinus. The number of these cases is considerably swelled by the circumstance that through the now routine procedure of radiographic examinations, a great many infected, or diseased areas about the teeth approximating the maxillary sinus are discovered, and the too vehement or injudicious use of the curette or other instruments in their removal frequently lead to secondary infection of this cavity.

Infection through the mouth is not limited to any age. Reviewing my cases for some years back I find that my youngest patient was five years old and the oldest seventy. The largest number, about 80 per cent, were between the ages of twenty-five and forty.

Etiology of Maxillary Sinus Lesions.

Dental lesions or anomalies, which are directly responsible or conducive to the involvement of the maxillary sinus may exist under two distinct and significant conditions, namely: (1) in the absence of disease of the surrounding soft or osseous tissues; (2) in the presence of disease of the surrounding tissues.

As these circumstances have a decided bearing upon the general consideration and treatment of the case, it will be advantageous to view the etiological factors from this standpoint and accordingly classify them under these headings. In their respective consideration the treatment indicated will be pointed out.

Etiologic Factors in the Absence of Disease.

(1) Traumatic injuries in the removal of, or in operating upon, or about the teeth.

(2) Fracture of the maxilla, or other traumatic injuries caused by external violence.

(3) Forcing of foreign bodies into the maxillary sinus.

FIGS. 80 and 81. Show the proximity of the maxillary sinus to the apices of the root ends.

(4) Impacted, malposed or supernumerary teeth within or in the proximity of the sinus.

Etiologic Factors in the Presence of Disease.

(1) An infected tooth or a portion of a tooth projecting through the floor into the maxillary sinus.

(2) An alveolar abscess evacuating into the antrum through a sinus formed in the intervening tissues.

(3) The extension of disease about a tooth, as a dental granuloma, suppurative osteitis, or periodontoclasia, may destroy the intervening bone until the sinus becomes involved.

(4) Cysts—radicular or follicular (dentigerous).

Other oral lesions which often involve the maxillary sinus are:

(5) Necrosis of the bone.

(6) Malignant growths.

(7) Syphilitic gummata.

Consideration of Accidental Openings Into the Maxillary Sinus.

The upper molars and bicuspid teeth are in such close anatomical relationship with the maxillary sinus that their roots form indentations into, or some even project through the floor of this cavity. (Figs. 80 and 81.)

Often they are separated only by a very fine lamella of bone or barely by the lining membrane of the sinus. The teeth which are so located are most frequently the second molar; next in order the first molar, the second bicuspid, the third molar, rarely the first bicuspid and still more rarely the cuspid. This proximity varies in extent as to the number

FIG. 82. Case No. 1. Shows probe passed into the maxillary sinus through the socket of the extracted third molar.

of teeth in different individuals. It is more marked in older than in young subjects. This, in a great measure, is due to the enlargement of the maxillary sinus, which, according to Cryer,* continues through life by progressive absorption of the cancellated bone.

In the removal of these teeth or in operating upon them, the maxillary sinus may be inadvertently opened, even where the laceration is not greater than is unavoidable in the operation. More often, however, the opening is caused by undue laceration or the unskillful or indiscreet use of instruments.

An opening into the maxillary sinus, in a person whose vital resistance is normal, frequently heals without subsequent complications; in those whose vital resistance is below par, it may lead to severe acute infection. Here, as elsewhere in the body, when bacteria alone are introduced, they are relatively easily eliminated or destroyed. In the presence of foreign bodies or dead tissue, which may shelter them against disinfecting agents or the phagocytic defenses of the invaded tissue, or which may even act as satisfactory pabulum for their incubation and multiplication, the bacteria may gain a dominating position. I have seen cases where such an opening cicatrized uneventfully with no treatment whatever. I have seen others where severe infection developed three or four days after the acci-

* Cryer: *Internal Anatomy of the Face.*

FIG. 83. Disease of maxillary sinus due to infection following the removal of an impacted third molar. Fig. 82 shows the same case with a probe passed into the sinus through the socket of the extracted tooth. See case history No. 1.

dent, and the local and general symptoms were those of an acute virulent infection.

When a local anesthetic is used, and the field of operation is relatively bloodless, such opening may pass undetected by the patient or the operator. Frequently, however, the surgeon may perceive an unusual yield in the application of his instrument, when, with careful probing, the cause of this can be ascertained. There may be a slight frothing of the blood which fills the tooth socket, and blood may escape through the nostril of the affected side. The patient may notice that in talking, the air under compression escapes through the same channel, and the voice presents a hollow sound.

Case History No. 1.

Mrs. G., age 27, presented with a profuse pus discharge through the right nostril. The patient was a rather frail woman 5 feet 2 inches tall and weighed 92 pounds. Her general health was poor and had been greatly impaired since the maxillary sinus became infected. The involvement of this followed the removal of an unerupted third molar. Fig. 82 shows a probe passing into the sinus through the third molar socket. Fig. 83 is an antero-posterior picture of the case and shows the diseased condition of the sinus. This patient was first seen by the author six weeks after the removal of the tooth. The pus discharge was preceded by no other symptoms, but what might be expected as a postoperative discomfort following the removal of the tooth. The patient was dismissed after the operation, and about ten days later infection of the sinus became evident. A rhinologist was consulted who established intranasal drainage and irrigation. This was kept up until the patient called on the writer. The third molar socket was freely opened and the soft as well as the osseous tissues showing pathological signs were removed. This wound was sutured and permanently closed. A new opening was made over the bicuspid region and the maxillary sinus was cleared of all degenerated and pathological tissues. Drainage was maintained through this opening for a week and irrigation for fifteen days. There was no further pus discharge, the opening was permitted to close and the patient was dismissed cured.

Because of this possibility of infection when a healthy maxillary sinus is accidentally opened, the patient must not be negligently dismissed. Measures should be taken to prevent untoward complications. These consist of irrigation and prevention of the ingress, in so far as this is possible, of infecting or irritating substances from the oral cavity. The irrigating medium should not be irritating, corrosive nor escharotic. A tepid sterile saline, or boracic acid solution, 2 to 4 per cent, is used until the return is clear or nearly clear. Next, dress the tooth socket with a strip

of iodoform gauze, carrying this slightly into the maxillary sinus. Twenty-four hours later the irrigation is repeated, and if, two or three days later, no suppuration ensues, all subsequent dressing should be confined to the tooth socket. In this way the closing of the orifice nearest the sinus is favored and it soon becomes obliterated by cicatricial tissue.

Fig. 84. The same case as Fig. 85, showing the portion of the root in the sinus.

If suppuration ensues the opening must be kept open until the pus discharge is completely eliminated, and thereafter so treated that its closing is aided and not hindered.

Foreign Bodies Forced Into the Sinus.

Forcing of foreign bodies into the maxillary sinus in operating upon the maxillæ or in the removal of teeth is not an uncommon occurrence.

When a tooth, a portion of a tooth, or part of an instrument is forced into the maxillary sinus, the removal of this is imperative. If it is not removed, violent symptoms may develop within a very short time following the accident, or serious infection, or neuralgic disturbances may ensue later. To one who is not acquainted with the presence of such a foreign body, the treatment of the case may be perplexing, as the symptoms do not always indicate the presence of a foreign body and are therefore often misleading.

Case History No. 2.

Mr. G. S., age 39, applied for treatment on August 26, 1919, complaining of headache, a general indisposition, pain in the temporal region, a foul odor and periodical pus discharge from the left nostril.

Fig. 85. Case No. 2. Shows diseased condition of the maxillary sinus into which a tooth root was forced.

He had been suffering from pulpitis of the upper left first molar on July 23, 1919, and had had this removed on the 24th. The tooth was broken in extraction and the lingual root was forced into the maxillary sinus. The patient was dismissed, and two weeks later sinusitis developed,

Fig. 86. Same case as Fig. 85. Showing the lining membrane of the maxillary sinus sagging through the socket of the first molar.

for which he applied to another dentist for treatment. Radiographs were taken which showed the root in the sinus. The second dentist undertook the removal of this, and the operation was followed up with irrigation for ten days. The pus discharge ceased and the patient was dismissed as cured. About two weeks later the symptoms returned, when the patient applied to the writer for treatment.

Further radiographic examination revealed the presence of a root in the diseased sinus. (Figs. 84 and 85.) As there was copious pus discharge the sinus was freely opened. The cavity was filled with coagulated masses

of pus and detritus. The sinus was thoroughly cleaned, the root removed and the lining membrane in the upper two-thirds of the cavity showing no clinical signs of degeneration, was left intact. Drainage was maintained through the tooth socket, and the patient was dismissed cured on September 25, 1919. He has since been seen at intervals for six months, and there is no sign of recurrence.

Figs. 87 and 88 show a small foreign body which proved to be a portion of a root over the apex of the suspected second molar before and after this tooth was removed.

This case presented a condition which sometimes occurs in the more chronic cases. When a portion of the floor of the maxillary sinus is carried away in the removal of a tooth and shows no tendencies toward cicatrization, upon prolonged irritation, the lining membrane of the sinus may sag through this orifice almost like a hernia. (Fig. 86.) This tissue becomes greatly inflamed and thickened, and has a tendency to bleed. It may be dark red or cyanotic blue in tint. It often resembles, and may be mistaken for, an epulis. When the tissue is not badly degenerated nor infected, it can be pushed back and the oral orifice closed by means of a sliding flap operation. When the mass shows signs of degeneration it should be resected well into the maxillary sinus and the aperture closed. (See Chapter on "The Closing of Acquired Openings into the Maxillary Sinus.")

Case History No. 3.

Mrs. A. J., age 44, Finnish, housewife, consulted the writer March 23, 1922. She had been complaining of neuralgic pain in the upper left maxillary, temporal and occipital region for four years. Lately her health had been rather poor and the vision of her left eye was becoming impaired. She applied for treatment to her dentist, who removed a bridge from that

Fig. 89 is the radiograph of the sinuses in which severe neural disturbances developed some years after the removal of the upper left third molar. Note that there is an alteration in the texture of the lining membrane, although it is not decidedly diseased.

side and also the second molar which supported this. There appears a small shadow over the apex of this tooth, which has the outline of a distinct foreign body. (Fig. 87.) The trouble continued and the patient was referred to the writer for treatment. Further radiographic examination showed the presence of this foreign body even after the removal of the tooth. (Fig. 88.) Antero-posterior radiographs showed no marked

pathological conditions of the sinus, but this also suggested the presence of the foreign body and obliteration of the right frontal sinus. (Fig. 89.) The sinus was opened by removing the outer plate of bone following the outline of the extracted second molar socket. The foreign body proved to be a portion of a tooth which was most likely a part of the third molar, which had been removed some years ago. It was lodged between the Schneiderian membrane and the bone. In this case the symptoms were

FIG. 90. Shows portion of a tooth forced high up into the maxillary sinus.

distinctly neuralgic in nature. The lining membrane was thickened but not degenerated and was left intact. Soon after the operation all neuralgic pain ceased and the patient was dismissed on April 14, 1922; on July 10 the patient reported back and had had no recurrence.

By means of radiographs, taken at different angles, the position and location of the foreign body can often be determined. At times our best efforts at radiographic examination will not localize it nor reveal its presence. A negative radiograph in these cases is not to be looked upon as positively reassuring, and security against later complications lies in the actual removal of the foreign body.

Method of Removal of Foreign Bodies.

In the event of this accident it is advisable to leave the parts in as nearly an undisturbed condition as possible. It is but rational that we should attempt to recover the foreign body through the passage of entrance, although it may drift into such a position that a new opening must be made to reach it. (Fig. 90.)

To remove foreign bodies from the sinus, expose carefully and enlarge

the original opening. It will often be found lying close to the orifice, or, if it is a portion of root, this may still be attached to a few shreds of tissue, when, with careful manipulation of a fine curette, or a hooked instrument, it can easily be recovered. When this is unsuccessful, a few syringefuls of saline solution may wash it to or through the orifice. In some instances all efforts at recovering the substance have proven

FIG. 91. Shows fracture of the maxilla, the line of fracture traversing the maxillary sinus.

fruitless and it was finally found to be lodged between the lining membrane and the bone. In the absence of infection the postoperative treatment is that indicated for accidental openings into the maxillary sinus.

Traumatic Injuries to the Maxillary Sinus.

Traumatic injuries caused by external violence, such as gunshot, fall, crushing blows, not infrequently cause fracture of a wall of the maxillary sinus, and the inflicted injury may be compounded into this cavity. These cases must be treated in the same manner as other infected wounds. Remove all foreign bodies, reduce the fracture, if fracture exists, and approximate the displaced or severed parts into the most favorable position for cicatrization. When there is no pre-existing nor other complication within the maxillary sinus, this will clear up with the healing of the other wound.

Case History No. 4.

Miss E. J., age 23, applied for treatment on January 1, 1920. Said she had slipped and fallen on the pavement the day before and injured her left maxilla. Examination revealed the displacement of the teeth, posterior

to and including the lateral incisor. The fractured portion of the bone and the contained teeth were projecting downward and toward the median line. The radiograph shows a complete separation of the bone which traverses the maxillary sinus. (Fig. 91.) There was considerable hemorrhage from the nostril of the injured side. The fracture was reduced and immobilized with appliances constructed for the case, and the former alignment of the teeth restored. The patient was dismissed on February 16. No untoward complications developed.

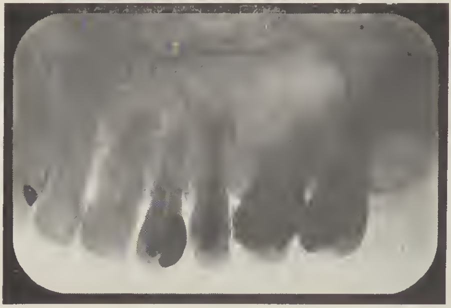


FIG. 92. Shows the way in which the maxillary sinus overshadows the roots of several teeth, and, when they are diseased, the difficulty offered in discerning the offending tooth.

Malposed, Impacted or Supernumerary Teeth in Maxillary Sinus.

Malposed, impacted or supernumerary teeth may develop in any wall of the maxillary sinus, where they may be placed in almost any position. The symptoms arising from these are at times of a distinctly neuralgic character, and the nervous reflexes may be so remote or complex that the association is difficult to explain. In others they may inaugurate a chronic and almost symptomless pathological condition which, by circumferential irritation, progresses until extensive tissue destruction has taken place and suppuration ensues. When such teeth are discovered, it is advisable to remove them upon reasonable provocation, to anticipate the development of graver conditions, for the exact extent of the pathological lesion cannot always be determined even by the closest scrutiny and thorough examination. Before undertaking the removal of the tooth the correlation of the anatomical structures should be studied, and after a close survey it should be approached from the most accessible point. In operating upon these cases one must be careful to avoid injuring the structures which are to be retained.

In the presence of disease, the following conditions may prevail: An

infected tooth, or part of a tooth, in close proximity of, or projecting into the maxillary sinus may act as the irritant; when an infected tooth containing a gangrenous pulp is so located the bacterial or bacterio-chemical irritation issuing from this causes inflammation and suppuration in the surrounding tissues. Frequently a sinus forms in the infected area or

FIG. 93. Shows the close proximity which often exists between a portion of a tooth root and the maxillary sinus and suggests the care essential in its removal to prevent forcing it, or carrying infection into this cavity.

FIG. 94. Advanced absorption of the bone about the first molar, which involved the maxillary sinus and caused severe infection there in a woman 32 years of age. A radical operation was necessary.

about the apex of an abscessed tooth, passes through the intervening bone and the pus evacuates into the antrum. (Figs. 92, 93 and 94.) These are the most frequent oral factors which cause involvement of the maxillary sinus. It is important, therefore, that in all cases of maxillary sinusitis, the teeth should be closely scrutinized and the condition of their pulps determined. The radiograph in itself cannot always be relied upon and other examinations, such as the faradic current, the thermal test, should

be applied. If a tooth is still doubtful, drilling into it will secure a positive diagnosis.

In acute maxillary sinusitis, or upon an acute exacerbation of a chronic case, all of the teeth on the affected side may become sore and very tender to pressure. Judicious care must be exercised, therefore, in determining if the teeth are, and if so just which tooth is, responsible for the disease. In the radiographic examination the overshadowing of several teeth by the maxillary sinus often creates the impression that roots (of the molars particularly) are actually penetrating this cavity. Every irregularity in the outline of the maxillary sinus wall which conforms to the outline of the roots of the teeth should be carefully studied. Cryer points out the fact that the progressive enlargement of the maxillary sinus is interfered with at points where the roots of teeth are present. This is often verified in close radiographic studies and in operations.

Having concluded that a tooth is the original cause of the disease, for the guidance of our treatment we must extend our examination to the following consideration: the anamnesis; the symptoms and signs present; the radiographic showing of all structures in this region; transillumination; the condition of the other accessory sinuses. From such an examination we can more correctly prognosticate whether the case can be cured by the comparatively simple expedients of removing the cause and following this with drainage, irrigation and securing ventilation. The consideration of cases in which this form of treatment is inadequate will be presented later.

Chronic Suppurative Osteitis.

Chronic suppurative osteitis, originating about abscessed or pyorrhetic teeth, often involves the maxillary sinus. This pathological condition, in its pathogenesis, resembles caries of bone. It progresses by an unlimited, slow disintegration of the bone, and may extend from any tooth in the maxilla until the maxillary sinus is reached. Here it may set up a suppurative inflammation, either by the continuity, or the contiguity of the disease, or through the blood current. The teeth within the diseased area must be carefully studied by other means besides the radiograph, as this in itself, in many cases, is misleading.

When the diseased area is circumscribed and small, this can be curetted through the enlarged tooth socket. Whenever we have reason to suspect, however, the presence of rarefication not disclosed by the radiograph, or when we are in doubt about the extent of the involvement of the adjacent teeth, it is better practice to raise the mucoperiosteum from over the region and by cutting away part of the overlying external plate of bone, the

entire diseased area is exposed to view and can then be thoroughly studied. If the mucoperiosteum of the sinus is intact, and the history of the case, the prevailing symptoms, and other diagnostic signs indicate that it has not undergone septic nor polypoid degeneration, the maxillary sinus need not be radically treated. The buccal lesion is cleared, the parts are restored to their former anatomical relationship, and a drainage point is provided and treated as any other septic wound.

Fig. 95. A dentigerous cyst in a young man 23 years of age. The cyst was lodged in the maxillary sinus and was infected.

Radicular and Follicular Cysts.

Cysts in the superior maxillary region often encroach upon the maxillary sinus. They more often invaginate the contiguous wall than invade this cavity. (See chapter dealing with Cysts.) In this connection may be considered the dental pericementoma, as in its pathogenesis it closely resembles those growths and requires the same mode of treatment.

Fig. 95 illustrates a dentigerous cyst which occurred in a young man twenty-three years of age. The cyst was infected, occupied practically the entire maxillary sinus and was associated with the malformed cuspid tooth. The curved root of this, shown in Fig. 96, was imbedded into the orbital plate. The patient was suffering for some three or four years from headaches, lack of appetite, insomnia, and chronic gastro-intestinal derangement. Very soon after the removal of the cyst and the tooth, his condition improved and his improvement kept pace with the cicatrization of the maxillary region.

Operation. The operative procedure should be similar to that described for suppurative osteitis or cysts in general. (See chapter, "Cysts.") When the maxillary sinus is not actually invaded,

entering this cavity should be carefully avoided. There are cases, however, where the bone between the cyst and sinus becomes entirely destroyed and there is a close adherence, over an extensive area, between the cyst sac and the lining membrane of the maxillary sinus. Where this obtains, it is more expedient to remove the entire dividing bone septum and membranes,

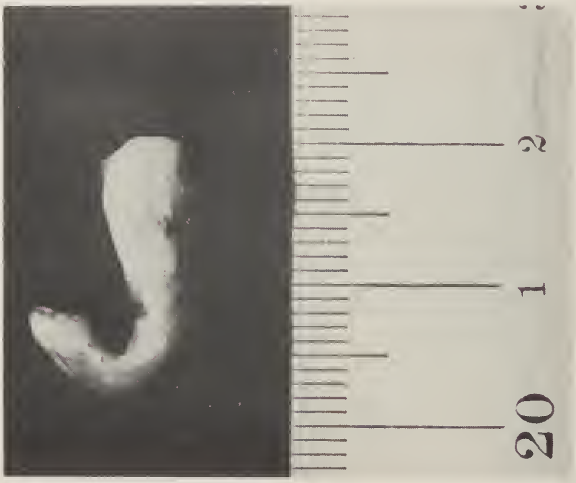


FIG. 96. Malformed tooth causing the cyst illustrated in Fig. 95. The curved portion of the tooth was imbedded into the orbital plate of the maxillary bone.

and to transform the two compartments into one cavity. With this condition the cyst will not recur. If we deem it more expedient to obliterate the cyst cavity, the cyst sac should be carefully dissected from the lining membrane of the sinus, leaving the subepithelial connective tissue exposed. The wound is treated in accordance with the indication of the case.

Necrosis of the Maxillary Bones.

Necrosis of the maxillary bones may result from traumatic injuries, from infection, mercurial or phosphorus poisoning, or it may be sequential to syphilis or tuberculosis. An infected maxillary sinus, complicated with the latter diseases, should receive the necessary systemic treatment. The local treatment consists of maintaining thorough drainage and irrigation and when a sequestrum forms this should be removed. Suppuration continues until all of the necrosed bone is removed or exfoliated. In many instances, the bed of the necrotic bone is filled with masses of

Fig. 97. Syphilitic necrosis of both sides of the maxilla. A large part of the body of the maxilla, the palate bone, the orbital plate, the nasal bones, the perpendicular portion of the vomer and also the left eye were destroyed. Note the first palate perforation, characteristic of this disease at the junction of the soft and hard palate. Patient was a man 56 years of age. He denied ever having had a venereal disease. The Wassermann test was 2 plus.

degenerated non-viable tissues which fall an easy prey to the infecting organisms present and suppuration continues until this is either removed by thorough and careful curetting, or is destroyed by liquefaction necrosis and replaced with healthy granulation tissue. There are cases where, either through necrosis, or through a slow disintegrating process of chronic suppuration, protracted over a period of years, large portions of the sinus walls become destroyed to such an extent that its integrity cannot be retained, or reconstructed. The utmost care must be exercised, therefore, in the preservation of all tissues which we hope to utilize to this end. When this becomes impossible, the only course left is to render the maxillary sinus accessory to the buccal cavity. The resulting deformity is corrected later by means of a suitable prosthetic appliance.

Malignant Growths in the Maxillary Sinus.

The principles governing the treatment of malignant growths in other parts of the body apply in these cases. The approved method in operable cases is thorough radical surgery, followed with radium or X-ray treatment. The prognosis is rarely favorable. The most frequent growths are the sarcoma and the epithelioma, the former predominating. They may develop in the buccal cavity and invade the maxillary sinus or they may originate within this cavity and grow outward. The utmost care should be exercised in recognizing them.

Syphilitic Gumma in the Maxillary Sinus.

A syphilitic gumma developing in the maxilla in most cases causes a perforation of the palate (Fig. 97) although any other part may be attacked or destroyed. As this destructive process is in a measure self-limiting, unless checked by systemic treatment, besides maintenance of hygiene very little can be done for it locally. When the destructive process has ceased the deformity, if not too bad, may be corrected with plastic surgery, where this is feasible, or with a prosthetic appliance. The lesion of the soft tissues often simulates, in its clinical appearance, a malignant growth and, when in doubt, serological examination should be made.

Diagnosis of Maxillary Sinusitis.

Typical cases of maxillary sinusitis present unmistakable, characteristic symptoms from which a diagnosis can easily be made. There are other lesions, however, which in many respects closely resemble maxillary sinusitis: also, maxillary sinusitis often presents atypical features. The

FIG. 98. Shows radiograph of healthy sinuses. Note the uniform penetration of the rays and the symmetrical formation and radiolucency of the two sides.

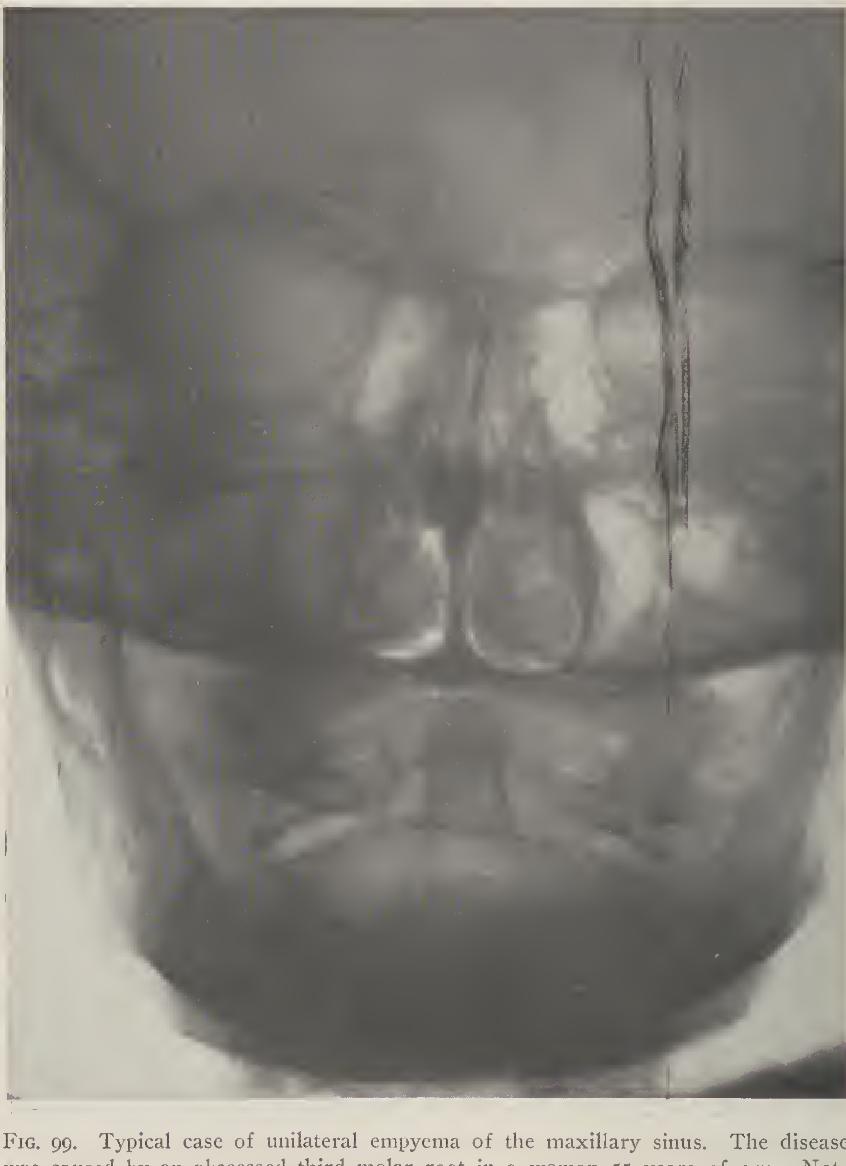


Fig. 99. Typical case of unilateral empyema of the maxillary sinus. The disease was caused by an abscessed third molar root in a woman 55 years of age. Note the contrast between the healthy and diseased sinus.

difficulty in diagnosing some cases is augmented by the consideration that, besides determining the presence of the disease, we must also ascertain the pathological stage of the tissues involved. A close, or nearly precise knowledge of this is essential, in deciding what treatment is needed for the case. In determining this, we must be guided by the anamnesis, the prevailing symptoms and signs, the etiology, the radiograph, transillumination, and often the response to conservative treatment, such as irrigation, drainage and ventilation; in still others, an exploratory operation must be resorted to.

Infection of the maxillary sinus is often secondary to diseases of the other accessory sinuses, or else some of the others may become infected from the maxillary sinus. It is not always a simple matter to determine which is the primary and which the secondarily infected diseased point. Because of their close anatomical relationship and the normally existing channels for their inter-communication, in the rational treatment of any one sinus it is important, therefore, that the condition of all of the others should be clearly understood.

Radiographic Examination of Maxillary Sinus.

Not unlike other diseases, in affections of the maxillary sinus, the radiograph is of inestimable value and is indispensable in the examination of the teeth and their surrounding tissues. It is important that the quality of the radiograph should permit of no misinterpretation. The diagnostic sign is that the diseased sinus appears more opaque than the healthy one upon the X-ray plate. (Figs. 98 and 99.) In the absence of other symptoms, the radiograph must not be looked upon as conclusive, and we must bear in mind that an anatomical anomaly, such as a difference in the size of the antra, or in the thickness of the bones, may produce similar differences in the radiograph. Dental radiographs in themselves are entirely inadequate in sinus diagnosis. Large plates must be taken through the head in such a manner as will permit of a comparative study of all the cavities of the head. I usually take two exposures at two different angles: one with the patient's nose and forehead resting upon the plate and the rays directed through the occipital protuberance at right angle to the plate. For the second, the patient's nose and chin are rested upon the plate and the rays directed vertically at right angles to the plate. This last will show more clearly the frontal sinuses and the maxillary sinuses without the overlapping of the malar bones.

Care must be observed that in taking the radiograph the central rays have a rectangular postero-anterior penetration. A lateral exposure causes overlapping of the cranial bones which obscure the maxillary sinus and

Fig. 100. Shows an alteration in the lower part only of a diseased sinus. The greater, upper part was clinically found to be normal as suggested by the radiograph.

FIG. 101. Is the radiograph of a diseased sinus, six months after a radical operation. There was no sign of recurrence. Note the alteration in the radiolucency, which most likely denotes the altered condition in the lining membrane.

FIG. 102. Case of a young woman 26 years of age. The primary focus in this case was the frontal sinus, which later involved the maxillary sinus and the ethmoid cells.

Fig. 103. Is the radiograph of a man 31 years of age. The condition originated with the removal of an upper, left, first molar. The maxillary sinus became involved and later all the other sinuses on that side. The entire course of the infective process occurred during three or four weeks. Neglect of caring for the primary infection was greatly responsible for its spreading.

may thus be misinterpreted. The error is often made by some radiographers, that they base a diagnosis on the comparison of the radiographs of one patient with those of another. This procedure must lead into error, because the radiograph of one individual can be the facsimile of no other and each case must be regarded, in this respect, as original and unique.

A close study of the radiograph should prove to be helpful in many other respects and may often serve as an index of the extent of the impairment of the parts. When the entire sinus appears opaque, this, with other clinical symptoms and signs, indicates that the sinus is diseased. In some cases, only the lower portion appears opaque while the upper part seems to be normal. (Fig. 100.) From this latter radiographic indication, we may infer, in a suppurative case, that the mucoperiosteum is not badly, or only in part deteriorated, and we may anticipate that if the suppuration is eliminated this structure will return to normal and does not need to be entirely removed. In the absence of suppuration or inflammatory symptoms, the opacity indicates the probable presence of a cyst, a neoplasm or polypoid degeneration. If the opacity persists after the suppuration has ceased, where no radical curetting had been done, it is reasonable to assume that the mucoperiosteum has become altered to such extent that its return to normal is not likely to occur; as a result of inflammation the lining membrane has been permanently changed in its histological structure; this, however, does not essentially denote a pathological state (Fig. 101); nor that there is a polypoid degeneration. When the etiologic factor has been removed and suppuration recurs with no apparent reason, following operation, and there is no change in the radiopacity, it is likely (1) that polypi are present, some of which are breaking down; (2) that the lining mucoperiosteum has degenerated to such an extent that it must be curetted out; (3) that the sinus is being reinfected from some other source; (4) that some part of the sinus was not cleaned out or that an infected part may be walled off by a bony partition. Often, an abnormality within the nose, a deflected septum, hypertrophy of the turbinate bones, enlargement of the ethmoid cells, severe repeated coryza, may interfere with the drainage and ventilation of the sinus, thereby complicating the case. In this event the case should be treated in coöperation with, the rhinologist. (Figs. 102 and 103.)

Transillumination. Transillumination, like the radiograph, is a helpful diagnostic aid, but it is open to the errors enumerated under radiographic examination. When the sinuses are healthy, all parts of the maxillary area, including the inferior part of the orbit, appear a brilliant deep red with lighter and deeper shadings, defining the comparative bulk or density of the transilluminated tissues.

There is a sense of light in the eye on the healthy side when closed and the pupil appears red. This cannot always be demonstrated. In a diseased sinus the penetration of the light is obstructed. The two sides show uniform transillumination to the level of the allæ of the nose, but above that the diseased sinus appears cloudy and almost opaque. The sense of light upon closing the eye, and red pupillary reflex are lacking.

Differential Diagnosis.

It is not always a simple matter to make an accurate differential diagnosis between cysts, neoplasms, and polypoid growths in the maxillary sinus. These conditions have many features in common, which confuse the inexperienced, and often the experienced, careful diagnostician. Cysts or neoplasms may originate within, or invade from without, the maxillary sinus, without altering the appearance or the anatomical relationship of the structures of the oral cavity. With their growth, there may be a distention of the maxillary sinus and with the turgescence there is absorption of any one or all of the bony walls which eventually may become so attenuated that pressure will elicit an eggshell crepitation characteristic of thinned out bone. Doubtful cases must be closely scrutinized and aspiration will often give us the necessary information. In the presence of a cyst, a fluid which varies in color from a light, straw colored yellow to a lighter or darker green may be withdrawn. This may be mucilaginous, limpid, or turbid in consistency. In the case of a growth, a difference in the resistance offered to the penetration of the aspirating needle may be perceived and we may withdraw a scanty amount of frothy, bloody tissue juice. When a neoplasm reaches an advanced stage and begins to break down there is a fetid and penetrating odor which is characteristic of malignancy and is attended by constitutional symptoms. The odor of malignancy can often be differentiated from that of empyema.

Polypi.

It is even more difficult at times to differentiate between polypi and malignant growths, and a close study of their clinical appearance is most helpful. Polypi appear as independent growths of varied size, or as growths of lobulated masses. They are somewhat sickly or dirty gray in appearance; they are pedunculated and seem to be studding the lining membrane of the maxillary sinus. Their gross histological appearance is that of a thick jelly-like material, confined within a very fine transparent membrane. In empyema many of these contain pus. They do not bleed as readily as malignant growths do.

Malignant Growths.

A malignant growth may appear as an individual mass or may be lobulated, but the tissues are more compact in texture than that of polypi. It springs more in homogeneous masses from an extensive base, and shows tendencies

of invading the surrounding structures. The growth may penetrate the other accessory cavities of the nose and there is neuralgic pain when the surrounding structures are invaded and pressed upon. When the radiograph shows a diffused invasion, accompanied with neuralgic pain and indications of malignancy in the patient's general health, and there is no suppuration, one may feel fairly certain that a neoplasm is present.

Inflammatory Affections of the Maxillary Sinus.

Inflammatory affections of the maxillary sinus may be classified under two general headings: acute and chronic.

Under these two headings several intermediate pathological states may exist, which may or may not be discernible. Although they are not marked by definite lines of demarcation it is well to comprehend these, as their recognition is helpful in the treatment of the case.

Acute states are: (a) The mucoperiosteum of the maxillary sinus is highly inflamed, edematous, and there is a scanty or more or less abundant mucoserous discharge through the nostril of the affected side. The mucous membrane of the nose on the same side likewise becomes inflamed, and the symptoms resemble, in many respects, those of a severe case of coryza.

(b) The inflammation of the mucoperiosteum reaches a more highly edematous state, becomes greatly engorged and thickened and there is a thick mucoserous or mucopurulent discharge through the nostril of the affected side.

(c) The pathological state of the tissues may be as that last described, but now there is a copious discharge of pus.

These successive pathological stages cannot always be traced, as, frequently, the first sign noted is a profuse pus discharge.

Other symptoms are pain and tenderness over the outer plate of the maxillary bone. When osteitis or osteoperiostitis develops, the cheek becomes badly swollen, which when involving the eyelid, the eye becomes closed. The pus may burrow through any one of the bony walls, but more frequently escapes through the *ostium maxillare* into the middle meatus of the nose. The pain is of a deep throbbing and neuralgic nature. This may be confined to the infra-orbital region, but is often reflected to the supra-orbital area, to the ear, to the temporal and the occipital region, or over the entire half of the head of the affected side. Before drainage is secured, there is a sense of fulness in the maxillary region, pressure upon the floor of the orbit which is aggravated by stooping, by bending over, or the forceful expulsion of air through the air passages, as in sneez-

ing or coughing. The general symptoms are those observed in acute infections.

The early inflammatory stages may terminate in resolution or suppuration. Suppuration usually follows upon prolonged irritation, or it may be determined by the ingress of an overwhelming number of bacteria, particularly the staphylococcus or the streptococcus. Upon examination or transillumination the affected side appears cloudy.

Treatment of Acute Maxillary Sinusitis and Empyema.

Acute stages of maxillary sinusitis or empyema yield in many cases to the simple expedients of removing the cause, securing drainage, irrigation and ventilation. These measures will be of no avail, however, towards a permanent cure, where the etiologic factor remains undiscovered, or its removal is neglected. If this is a diseased tooth, the socket of this may be used for drainage; or, when there is an oral lesion through which a communication with the maxillary sinus already exists, this can be transformed into a favorable channel for the same purpose. In the absence of complication from infection of some other of the sinuses, the symptoms yield in most cases very speedily to this form of treatment. It may be well to remark that in some individuals, even though all etiologic factors are entirely eradicated and the parts have cicatrized, the once infected maxillary sinus permanently remains a *"locus resistantiæ minoris"* and there will be a degree of predilection for the recrudescence of the disease. In the event of repeated recurrences after all buccal lesions have been eliminated, the case should be handled in coöperation with the rhinologist.

Chronic Empyema. Chronic empyema of the maxillary sinus is always preceded by an acute stage. The chronic stage is frequently painless, particularly when there is free drainage. In some instances there is pain which is of neuralgic character; this may be periodical, intermittent or fairly constant. The inflammatory symptoms are mild but may become fulminating from time to time when there is no adequate drainage, when the drainage point becomes occluded or when the patient's vital resistance is lowered for some reason.

Symptoms of Chronic Empyema. In chronic cases, the symptoms are pathognomonic. There is a free and copious discharge of pus from the nostril of the affected side; when both antra are involved, which is a rare condition, there is a bilateral discharge. The odor of the discharge is offensive, resembling that of decomposing animal or organic matter and is perceptible, not only to the patient but also to those in their proximity, or even at a distance. The quantity, the frequency of accumulation, and evacuation of the pus varies in different

individuals. The patient usually has the troubled appearance of the sufferer, and a sallow, pasty, clammy complexion. He often complains of frontal headache, insomnia, attacks of vertigo, lack of appetite, nausea, vomiting and a general gastro-intestinal derangement. In the morning, or even during the night, he is obliged to rise to clear the nasal passages and pharynx from the coagulated accumulation of pus.

In the chronic cases the lining membrane may reach the following pathological states:

(1) It may be so affected that upon the removal of the etiological factor, with drainage and irrigation, the tissues repair and may return to a healthy state.

(2) It may undergo a liquefaction necrosis leaving the bony walls bare with smaller and larger patches of the membrane still adherent.

(3) It may become greatly thickened, undergo fibroid degeneration and may or may not present polypoid growths.

(4) In extreme stages, besides the soft tissues, the bony walls become necrosed or, to be precise, they are destroyed by suppurative osteitis and pressure necrosis. By this process any wall of the maxillary sinus may be perforated and permit of the escape of pus. The bone becomes highly attenuated, so that it yields to pressure, not unlike a crepitating cyst wall, and can easily be penetrated with a sharp instrument. The overlying mucous membrane most often appears normal; in some instances, however, there are marks of discoloration.

With the exception of the first described condition, all of the others must be treated by radical surgical measures.

The degree of the pathological state of the maxillary sinus is not always clearly defined, and at times cannot be satisfactorily determined without opening into it. Before resorting to this, however, all diagnostic data should be carefully weighed and deliberated upon. The onset of the active symptoms does not necessarily indicate the period during which the disease has existed. A dormant infection may be present for a long time without causing disturbing symptoms which can be activated by an injury, an admixture of different strains of microörganisms or by a change in the environment of the microörganisms. We must also bear in mind that the phase of virulence of the infecting microörganisms as well as the vital resistance of the patient are determining factors in this.

Recently acquired acute cases will yield to the treatments described in connection with these conditions. In chronic cases, or acute exacerbations of these, however, we must often resort to radical surgical operations.

Old Method of Treatment.

It may be pertinent here to comment on some obsolete methods of treating these conditions, which are even today practiced by some men.

One of these methods depends upon a perpetual drainage point, secured through the socket of a tooth. The orifice is kept open by means of a hard rubber plug projected into the sinus, made part of a dental plate, or saddle, and is held in place by being attached to the adjacent teeth. The patient removes this twice, or more often, daily, and the pus, often in copious quantities, is permitted to escape. I have seen individuals who have worn such appliances from one to ten, or even twelve years. Another equally inefficient appliance is a metal tube constructed on the same principle.

All methods which tend to perpetuate the disease by permanent drainage must be disapproved, as they are wrong in principle as well as in practice. Even though the patient can often be kept in comparative comfort with one of these appliances, in our present light and understanding of the baneful influence of infections upon the system, suppurative conditions should be eradicated. It cannot be too emphatically stated, therefore, that the treatment of these parts must be based on sound surgical principles; i.e., (1) remove the etiological factor, (2) remove the diseased parts, and (3) restore, as nearly as possible, the former anatomical relationship and the functional integrity of the remaining structures.

Radical Operation Upon the Maxillary Sinus.

A number of ingeniously devised intranasal, or intranasal combined with intrabuccal operations have been advocated by different authors. The virtue is claimed for each that it tends to minimize or to depart from excessive intranasal or maxillary mutilations caused by other operations. Some of these are performed with the object of securing a permanent, irreparable and unobstructable point of drainage. There are cases, undoubtedly, where proper drainage and ventilation of the accessory sinuses and cells are obstructed, or entirely prevented by chronic inflammation, abnormal development, or hypertrophy of their walls, or an abnormal condition of the nasal septum, or of the turbinate bones, in which a partial removal of these structures is indicated. These are types of cases which belong to the domain of rhinology. But, where the etiologic factor is a buccal or dental lesion, which can be reached and eradicated without a permanent mutilation, such a method does not commend itself to our better judgment.

Of the more often practiced radical operations, we may mention the alveolar or Cooper operation; the intranasal; the Kuster; the Caldwell-Luck; the Denker and the Canfield-Ballenger operations. One is tempted to enter into a detailed consideration of each one of these, but in accord-

ance with the general trend of this chapter, it shall be confined to those only which can be adapted to the needs of the oral cavity and which have given gratifying results in my hands.

All operations upon the maxillary sinus, when executed from within the oral cavity, can be performed under nerve blocking anesthesia by

Fig. 104. Note the distance which commonly exists between the canine fossa and the maxillary sinus.

anesthetising the superior maxillary division of the fifth nerve in its passage through the sphenomaxillary fossa, supplemented with injections of the infra-orbital, the anterior palatine and the posterior palatine nerves.

Diseased Tooth as a Factor in Antral Disease.

Let us consider the most common buccal etiologic factor, a diseased tooth which is to be extracted, or a tooth socket from which the diseased tooth has been removed but which remains patulous. When there is good reason to believe that drainage and irrigation will suffice to control and cure the case, the tooth socket can be enlarged by removing the bony septæ dividing it, or by curetting away some of the bone. Care should be taken that the adjacent teeth are not mutilated, nor infringed upon. A healthy tooth, or a diseased one which can be restored by treatment, without jeopardizing later the condition of the maxillary sinus, should never be removed, merely to secure drainage. Where drainage alone is desired this can be secured more readily with an intranasal puncture. The Cooper or alveolar method has often been criticised, because of the probability of secondary infection from the oral cavity. The violent infections which often follow accidental openings into the maxillary sinus would rather bear out this contention. But here, as elsewhere, in cases of injury to the body, all factors controlling infection should be considered. Frequently a chronic infection may have been existing at this

point which becomes activated by the injury itself, by admixture of extraneous microörganisms, or by a change in the environment. On the other hand, we are impressed by the many cases in which these openings cicatrize rapidly with no signs of infection whatever. In still others, where infection supervenes, recovery and cure follow with such readiness, that one is almost inclined to believe that the oral communication favors the case.

When, contrary to expectations, the disease fails to yield to a conservative treatment as suggested, or where, after a temporary remission, recrudescence of the disease occurs, we may conclude that an uncorrected condition exists which retards, or prevents the cure. The most frequent causes for this are: (1) a portion of sequestrum; (2) an infected compartment within the maxillary sinus which has not been reached; (3) diseased and pus containing areas within the alveolus which have not been eradicated; (4) undiscovered infected tooth structures. Frequently a tooth, which is not directly responsible for the disease, becomes infected as a result of the degeneration, or destruction, of the surrounding tissues. The nerve trunk and blood vessels which supply the tooth cannot remain healthy in a diseased environment, and, as a result, it becomes a potent factor in the recurrence of the disease, wherefore it is best removed. Again, when we can ascertain that the tooth, though its root appears to project into the maxillary sinus, still retains its vitality, and is covered by normal mucoperiosteum of the maxillary sinus, through which the nerve and blood vessels supplying the tooth traverse, the utmost care must be exercised in the preservation of these tissues. Other conditions to be considered are the possible infection from some other accessory sinus, or an advanced stage of pathological or polypoid degeneration of the lining membrane.

All tentative measures to avoid radical curetting and a complete removal of the lining membrane of the maxillary sinus are justified unless our diagnosis definitely indicates the need of a radical operation. Coakley states that a curetted maxillary sinus is eventually filled in with granulation tissue. Other authors believe that the sinus walls become covered with cicatricial tissue, which is different in its histological structure and thicker than the original mucoperiosteum. This is more in accord with our clinical findings. The new lining membrane may or may not be covered with epithelium and when epithelialization does occur, this, unlike the original, is not ciliated. Whichever the case may be, we are certain, however, that granulation tissues replace the removed membrane, and we know that repair tissue is always less resistant to infection than the original lining membrane was. Also the means of cleansing carried out by the ciliated epithelium is diminished.

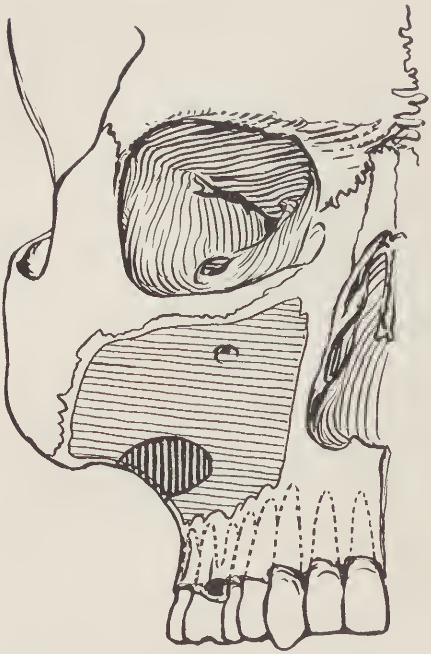


Fig. 105. Shows the anterior view of the opening for radical operation upon the maxillary sinus.

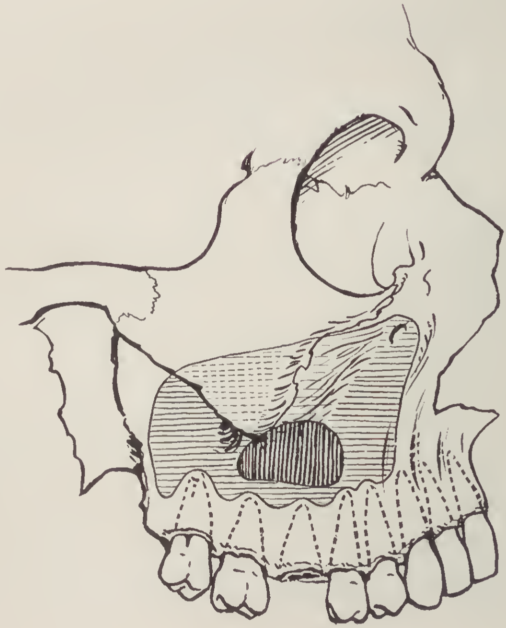


Fig. 106. Shows side view of opening for operation upon the maxillary sinus.

Fig. 107. Shows line of incision of the oral mucosa for operation upon the maxillary sinus.

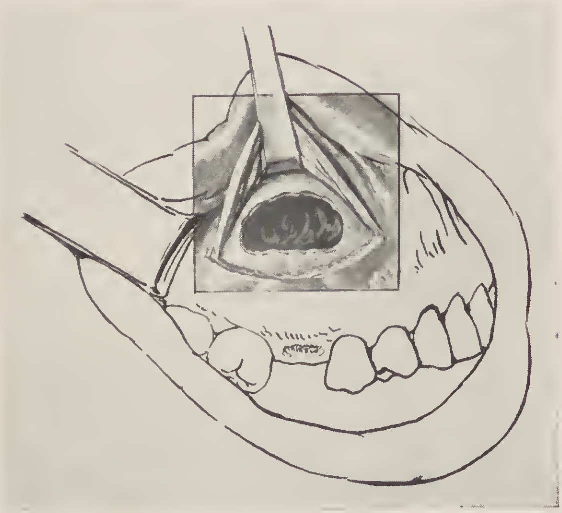
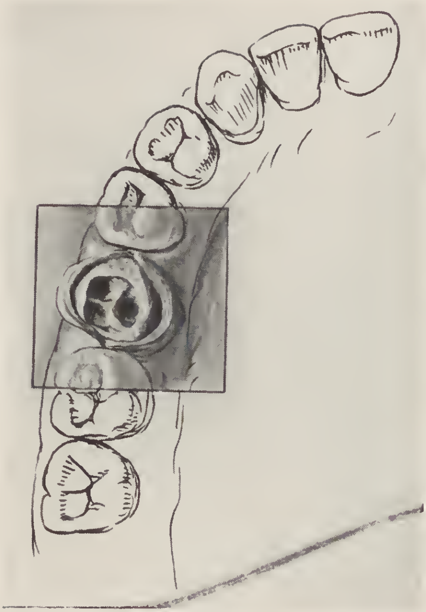


Fig. 108. Shows the bone exposed and portion of it removed, for opening into the maxillary sinus.



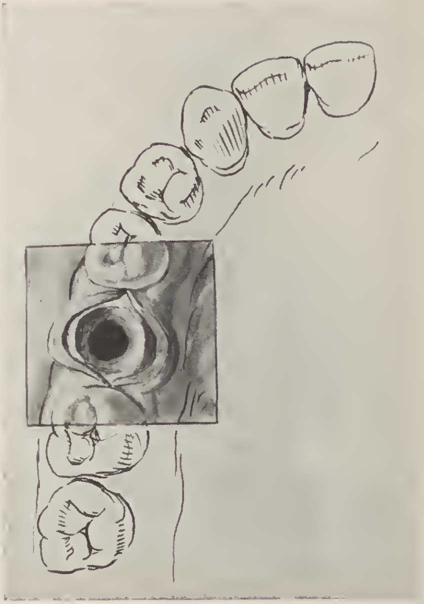


Fig. 109. Shows the method of opening, exposing the tooth socket where the bone area is necrotic or infected.

Fig. 110. Shows the tooth socket cleared for drainage, where this is desired.

Radical Operation for Sinusitis.

In text books and current literature it is commonly advised that oral openings into the maxillary sinus should be made through the canine fossa. In practice, this opening is not, in the average case, the point of vantage. Examination proves that in many instances, of all the walls of the maxillary sinus this is the thickest. (Fig. 104.) This point also forms the most anterior corner of the antrum and makes the inspection and accessibility of the more posterior portions, particularly the floor of this cavity, or the involutions formed by the turbinate bones, rather difficult, if not impossible. Another grave objection is that the root ends of the cuspid and bicuspid teeth are so close to this region that they are often injured in the operation. A number of cases have been brought to my attention in which, though the teeth themselves were not implicated, the nerve branches which supply the two incisors and cuspid teeth were severed. While this may appear negligible at the first glance, in practice it frequently creates conditions and complications which are not easy to cor-

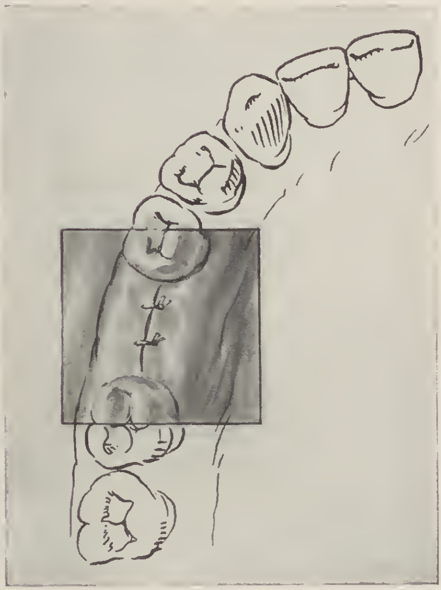


FIG. 111. When drainage and irrigation is to be carried on through the tooth socket alone, the mucosa is sutured into place and the gauze is introduced between the sutures.

rect. In these cases the injured teeth have to be subjected to complicated and unlooked for treatment and in some instances the neuralgias created could not be eradicated, neither by the treatment nor the removal of the teeth. I have found that opening through the base of the malar process and above the apices of the teeth offers several advantages: (1) The bone is much thinner here than at any other approachable point. (2) This opens into about the center and somewhat anterior portion of the cavity and renders inspection clearer and the surgical field more accessible. (3) The area can be reached without in any way infringing upon the teeth. (Figs. 105 and 106.)

When it becomes necessary, for the above stated reasons, to resort to a radical operation, a free, crescent-shaped incision, about half an inch above the alveolar ridge, is made, extending from the first bicuspid to about the second molar tooth. (Fig. 107.) The mucoperiosteum is raised and the buccal aspect of the maxillary bone exposed. The outer plate of bone is cut away with gouges and Rongeur forceps until the aperture permits of thorough inspection and exploration of the maxillary sinus. (Fig. 108.) When the parts are disclosed to view in this manner,

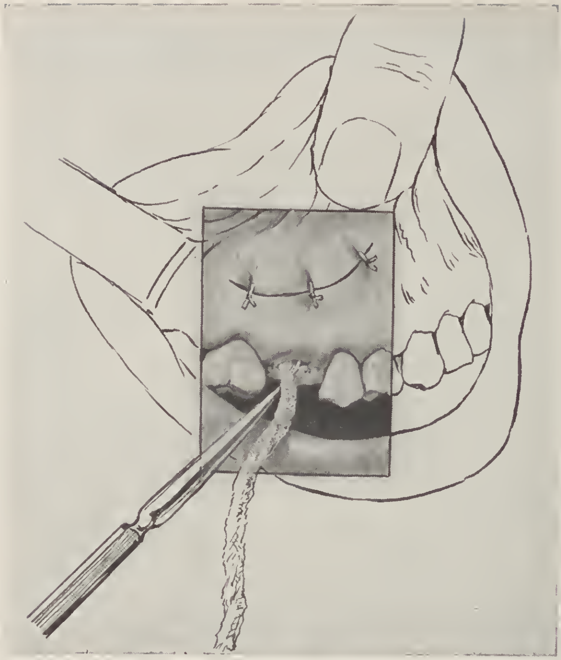


FIG. 112. The mucoperiosteal flap is sutured into place over the tooth socket and also over the newly formed opening; drainage and dressing can be carried out at some point between the sutures.

the condition of the bone and the adjacent teeth should be carefully observed. I have found in a number of cases that the floor of the sinus contained one or more smaller and larger walled off cavities containing pus, at the site from which a tooth had been removed years before, despite the fact that the buccal tissues appeared to be normal and the radiograph negative. Upon the removal of these, a rapid recovery followed in instances where several intranasal operations had proven to be futile.

The bone septæ of the alveolus proper are removed, with the lingual and buccal plates of bone left intact. (Figs. 109 and 110.) After all the diseased tissues have been removed and the mucoperiosteum sutured into its former position the cavity is irrigated and packed through the anterior part of the incision and the enlarged socket of the tooth is permitted to close. (Figs. 111 and 112.) When cicatrization ensues, the only remaining deformity is that produced by the removal of the tooth. The operation is in all its features similar to the Caldwell-Luck operation, except that the tooth socket is substituted for the nasal opening. This principle permits of

a very wide range of adaptation and can be modified to the needs of the case in hand.

Modified Kuster Operation.

When the tooth socket is so situated that it does not offer a ready, nor available drainage point, a modified Kuster operation will prove to be expedient: for example, when an opening into and infection of the sinus is caused in the removal of an impacted third molar, or when a foreign body is so lodged that it cannot be reached with the operation described before. As in the Kuster operation, the sinus is opened on the outer surface of the maxillary bone and a portion of its outer wall is removed. As in the Caldwell-Luck operation the mucoperiosteum is carefully raised from the area and when the operation is completed this is restored and sutured into position. Drainage can be secured between the sutures at a convenient point.

Postoperative Treatment.

The cavity is dressed with iodoform gauze, which is removed no sooner than in forty-eight, and frequently not till after seventy-two hours. The removal of the dressing should be done with the utmost care to avoid secondary hemorrhage. While some surgeons do not renew the dressing, it will be found that iodoform gauze, if repeated for a week or ten days, has a most salutary influence upon cicatricial tissue formation. In irrigating, irritating or escharotic drugs should not be used. A tepid normal saline, or mild boric acid solution will prove to be all that is desired. Recently I have been using one per cent. dichloramin T, in chlorcozene oil paraffin solution, which was incorporated into the gauze dressing or was introduced with a syringe. I have failed to observe any marked efficiency in aiding these cases. Unless there is hemorrhage after the first dressing, the cavity is not packed tightly again; just enough gauze is introduced to absorb and drain the inflammatory serumal exudates and the blood if there is any degree of hemorrhage. If all diseased tissues have been removed and there is no complication from any of the other accessory sinuses or the nose, there should be no suppuration following the operation. There is some doubt in the minds of a great many men regarding the advisability, or the need for dressing, or irrigation of the maxillary sinus following a radical operation. This operation is always followed by marked hemorrhage in the first place and cicatricial serumal exudations which collect there and may readily break down and become infected. To avoid this it is advisable therefore to drain and irrigate following the operation until discontinuing this is indicated.

I have omitted a detailed consideration of the anatomical relationship of the maxillary sinus to the other accessory sinuses and the nose; also,

all such diseases of the antrum which have other than dental or oral origin; those intranasal examinations which are often helpful in making a diagnosis, and other features which are strictly within the domain of the rhinologist. But it is well to bear in mind that, in the comprehensive study of the maxillary sinus and its diseases, it is essential to be thoroughly familiar with the internal anatomy of the head and the intricate relationship which exists between the various sinuses and cells of the facial and some of the cranial bones. (See Cryer's *Internal Anatomy of the Head.*) Furthermore, we must not overlook the fact that there is a coördinate functional relationship between all of these structures and that the pathological state of one often complicates some one or all of the others.

CHAPTER XII.

The Closing of Acquired Oral Openings into the Maxillary Sinus.

The closing of acquired openings, which lead from the oral cavity into the maxillary sinus, is not always a simple matter, from a technical standpoint; and the attempt is not always followed by success.

These openings occur, more often in the molar area, than in the anterior part of the mouth.

The causes for their formation are: extensive tissue destruction, due to a pathological process, such as, necrosis, cysts, chronic suppurative conditions about the teeth; traumatic injuries; the removal of neoplasms; sloughing, due to undue surgical trauma, traction upon the tissues, or impaired blood supply; faulty approximation of the tissues in operations upon the maxillary sinus and faulty postoperative dressings.

Success in their closing is dependent upon the observation of those principles which are essential in all types of plastic or corrective surgery. Of these we may mention: preservation of all available tissues; proper vivifying of the wound edges and the removal of scar tissue; correct approximation and suturing of the tissues; avoiding or minimizing surgical trauma; avoiding undue traction upon the approximated tissues; avoiding impairing the blood supply.

The most frequent causes of failure are: excessive surgical trauma; impaired blood supply due to severing of, or pressure upon the nutrient vessel; undue traction upon the flaps of tissues; pressure of the underlying bone when the tissues are stretched too tautly over it; improper suturing.

Case History. The case cited and illustrated below will bring out many of the essential features in a typical case. The patient, male, 29 years of age, had been suffering for a number of years from chronic recurrent abscesses in the upper left incisor region. A portion of bone which contained the three missing teeth was exfoliated and when cicatrization ensued, a considerable hole remained, which communicated with the nose and the maxillary sinus. (Fig. 113.)

The edges of the tissues were pared and the mucoperiosteum was freely detached from the bone. (Figs. 114 and 115.) The sharp edges of the bone

FIG. 113. This is a photograph of a large opening which communicated with the nasal cavity and the maxillary sinus. This was the result of necrosis, following abscess of the lateral incisor. The problem in this case was whether the opening should be simply covered with a prosthetic appliance, or closed first by surgical means. There are many advantages in closing these openings by surgical means first and to later covering the gap with a prosthetic appliance. This was done in this case, and the method used is shown in the following illustrations.

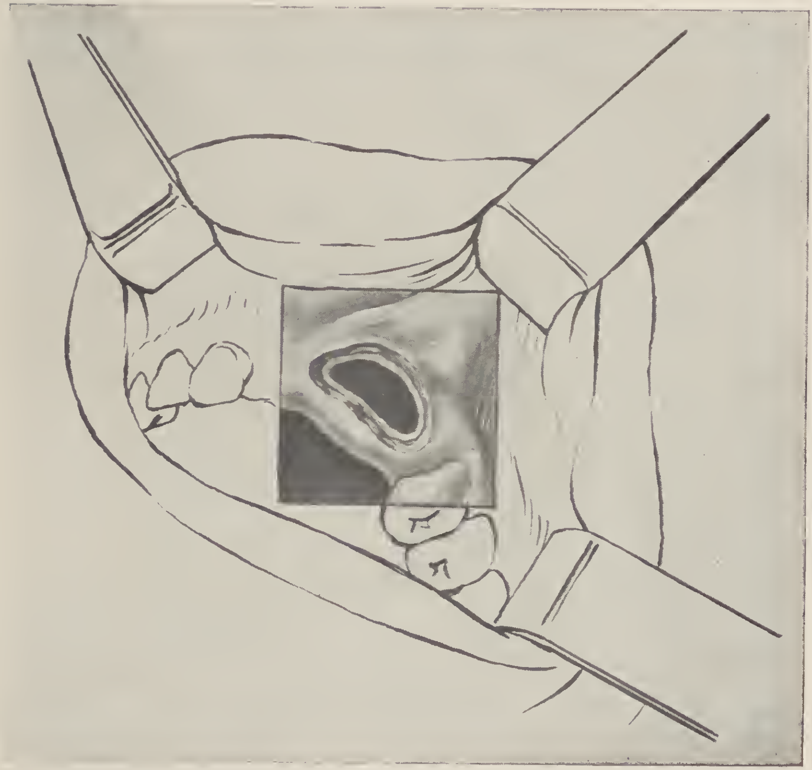


FIG. 114. The first step in the operation is the removal of the scar tissue which attached the mucosa to the bone. Simultaneously the surfaces to be approximated are being pared.

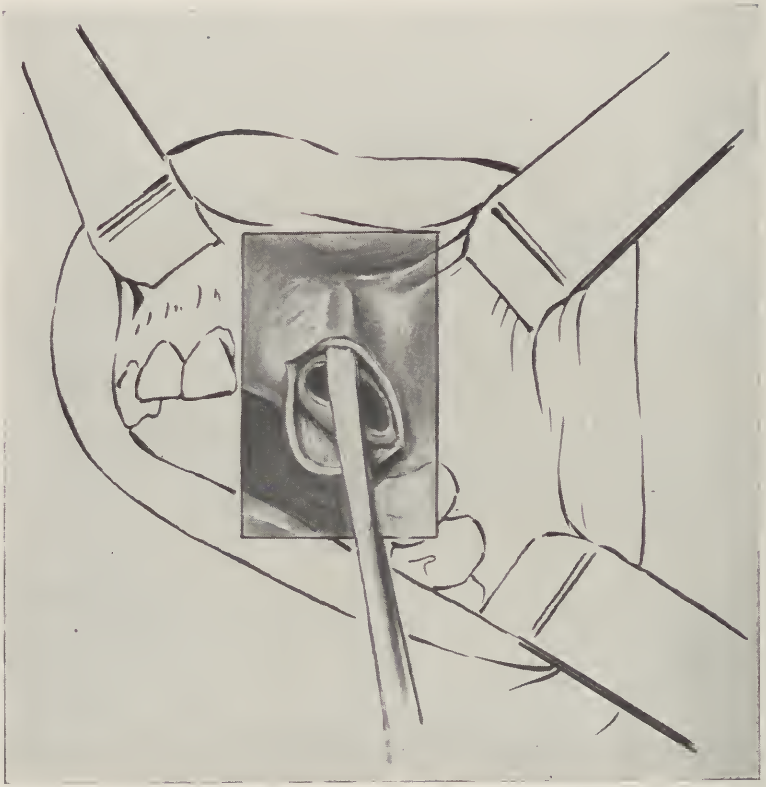


FIG. 115. The mucoperiosteum is freely undermined and raised on the palatal and on the labial surfaces.

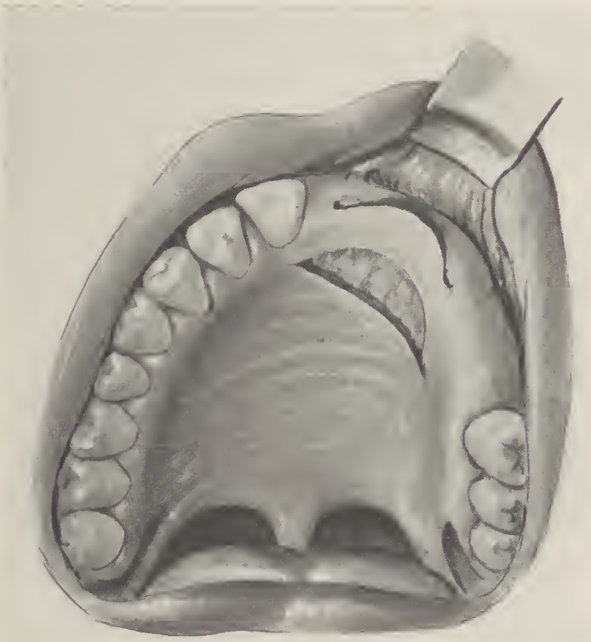


FIG. 116. It is desirable to nearly evenly approximate the palatal and the labial flaps. As the palatal tissues are rather unyielding, an incision is made at some distance from the edge, to compensate for this.

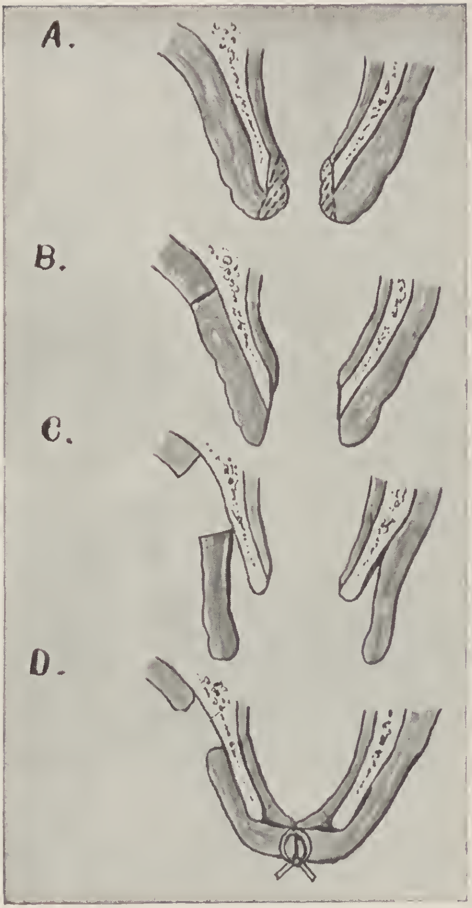


Fig. 117. A diagram showing the successive steps in the operation. A indicates the amount of tissue to be removed; B the wound edges vivified and pared; C the flaps raised and the palatal tissue just slid forward and severed as the diagram suggests; D the tissues approximated and sutured into place.

FIG. 118. Photograph of the case after cicatrization has taken place.

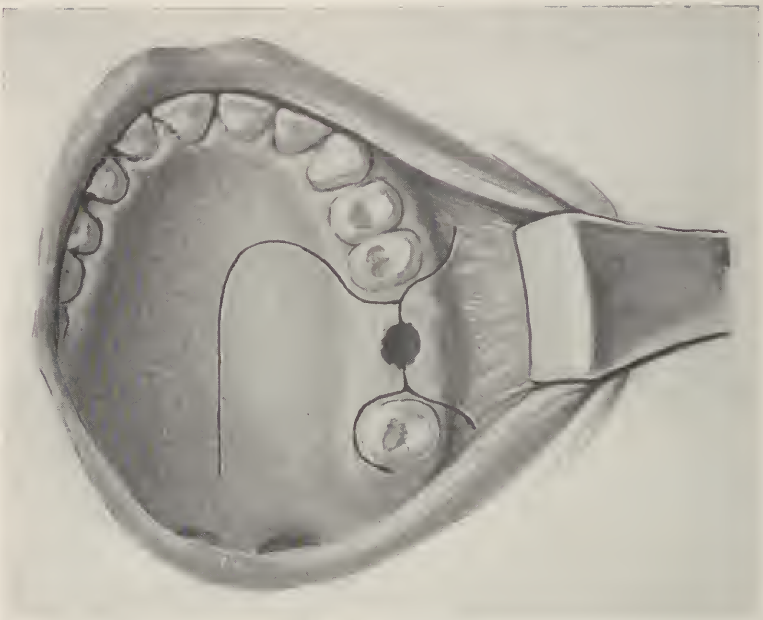


FIG. 119. Incision of the mucosa on the palatal and buccal aspect for radical closing of opening into the maxillary sinus.

were trimmed down to prevent pressure upon the overlying flaps; the palatal tissue flap was incised to render this more yielding in the approximation and to reduce excessive tension. (Fig. 116.) Fig. 117 represents a cross-section of the various steps. The tissues were next brought into apposition and sutured with horse hair. Fig. 118, from a photograph, also shows the final result obtained in the case.

It may be observed that the labial and buccal tissues, as a rule, are more elastic and more yielding than the palatal tissues. The palatal incision tends to overcome, or in a measure it compensates for this lack of elasticity. The incision should never be made too close to the edge of the wound and a strip of tissue as broad as possible, with a liberal blood supply, should be secured. Close attention should be paid to the nutrient vessels and their severing must be carefully avoided. The exposed area of bone will granulate and become covered with epithelium. Sharp edges of bone, which may cause angulation and pressure of the overlying tissues, should be smoothed, but no part of the bone should be unnecessarily removed. The resting of the soft tissues upon a healthy bone surface conduces to more prompt and favorable results.

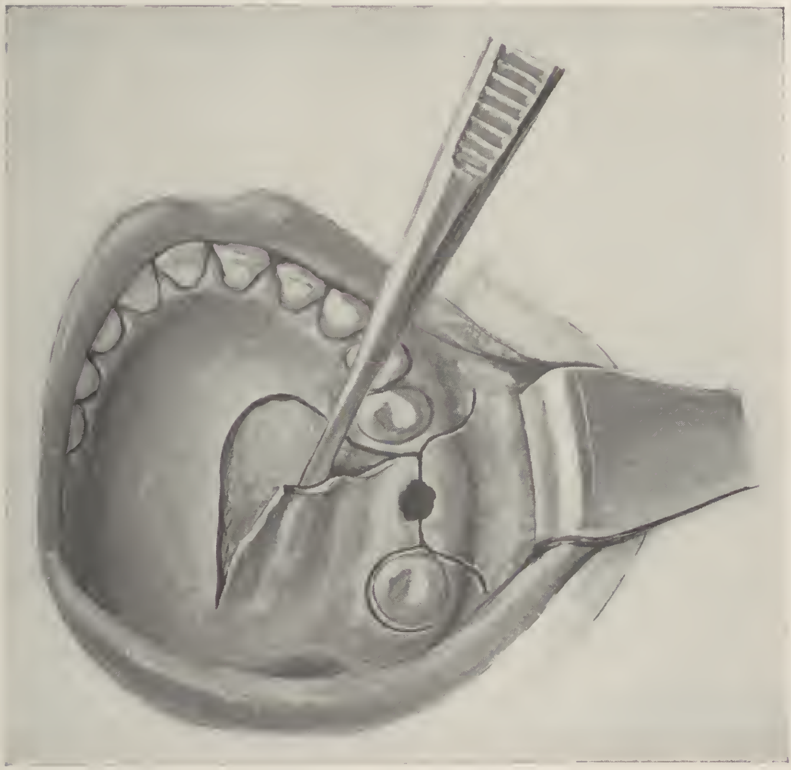


FIG. 120. The palatal flap raised.

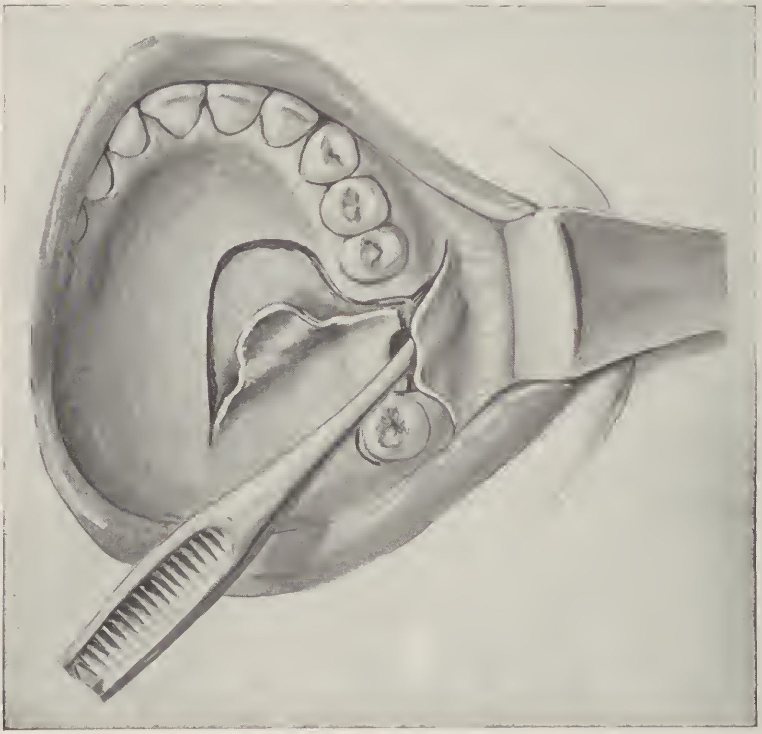


Fig. 121. The buccal flap raised and deeply undermined.

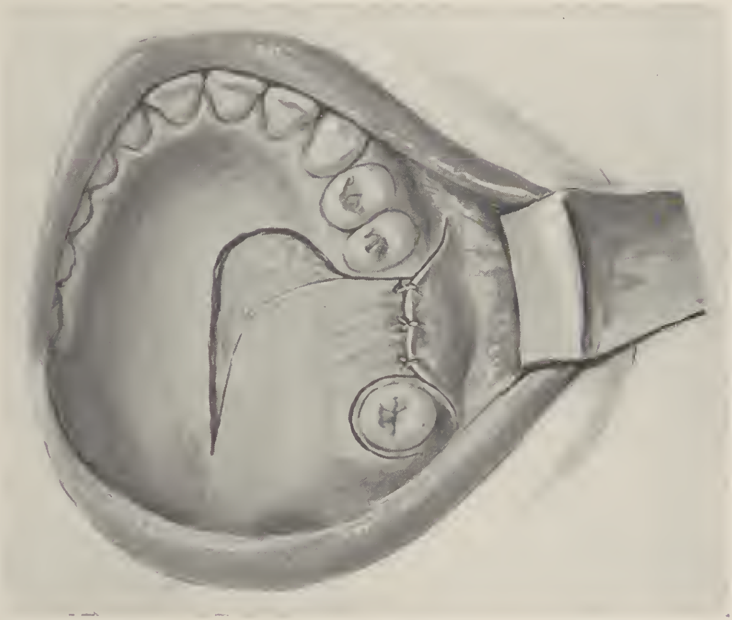


FIG. 122. The palatal is tucked underneath the buccal flap and sutured into position.

As stated before, this operation is not always followed by success. The chances of success in closing these openings decrease with the number of attempts made. This is largely due to the fact, that, with each attempt the opening tends to be larger and there is an increased amount of cicatricial tissue which cannot be depended upon in plastic work.

Where the opening is too large, where the available tissues are scant or where several less formidable sliding flap operations have failed, the operation described by Dr. H. S. Dunning * has been employed with very gratifying results.

In this operation, the palatal mucoperiosteum is utilized principally. As illustrated in Fig. 119, an incision is made down to the periosteum, bisecting the opening to be closed, when this is upon the alveolar ridge. This incision is carried anteriorly towards the bicuspids, along the median line posteriorly to the vicinity of the junction of the soft and hard palate. This flap of tissue is raised from the bone, leaving the periosteum intact as far as this is possible. The flap thus secured is quite thick, is of considerable size and containing the anterior palatine artery, is abundantly supplied with blood. (Fig. 120.)

* H. S. Dunning, *Journal A. M. A.*, November 20, 1920.

The area of the opening is cleared from all fragmentary soft tissues and the bone edges are smoothed. The buccal aspect is thoroughly undermined next and a second flap is formed, carrying this considerably upon the outer surface of the maxillary bone. (Fig. 121.) The edges of the palatal flap are tucked underneath this tissue and sutured into place. (Fig. 122.)

When the flaps are liberated to such an extent that they can be freely approximated to cover the gap, they are sutured with catgut, horse hair or silk. Horse hair is the most adaptable suturing material for the purpose, as it is more pliable than catgut is; though thin, it is strong enough, and it is not so likely to become infected as silk.

CHAPTER XIII.

Cysts of the Oral Cavity.

A cyst is a circumscribed cavity with a well defined, organized, lining membrane containing a fluid or semi-fluid substance. This substance may be sterile or infected.

The most common types of cyst formations found in the oral cavity and jaws are the radicular or root cysts, the follicular or dentigerous cysts, and the ranula, which is a form of retention cyst. The rarer types are the mucoid and multilocular cysts.

Radicular Cysts. Radicular cysts are invariably associated with devitalized or pulpless, infected teeth. Of the many theories as to their formation the following seem to be the most plausible and most in accord with our clinical findings. When a nidus of infection has been established in the apical region of a tooth, a reaction, with a tendency towards repair, takes place in the surrounding tissues. This may also serve as a barrier to the spreading of the infection.

The very earliest pathological manifestations are changes in the pericemental membrane, which may lead to the formation of a pericementoma (dental granuloma). (Fig. 123.) These growths are the result of a productive inflammation induced by the irritation of pyogenic, or non-pyogenic organisms, such as the streptococci of the viridans group, and may or may not contain pus.

Etiology of Radicular Cysts. A pericementoma, at some stage of its development, frequently undergoes central necrosis. This may be due to deficient nutrition, overwhelming activities, or the virulence of the microörganisms present and their toxins. A cavity is thus formed, containing pus or necrosed detrius, and becomes lined with epithelium thereby establishing a cyst. (Fig. 124.)

The epithelial lining, according to Dependorf and also Black, is derived from the epithelial chain indigenous to the pericementum. Malassez believes that the epithelium is derived from stray epithelial rests, which are remnants of the enamel organ. This latter theory is opposed by Black and by Fisher. These investigators found that the epithelial cells lining such a cyst cavity, in their histological appearance, and in their

reactions to various dyes, are more analogous to the epithelial chains of the pericemental membrane. They maintain that the epithelial rests derived from the enamel organ are a decadent structure in all the higher

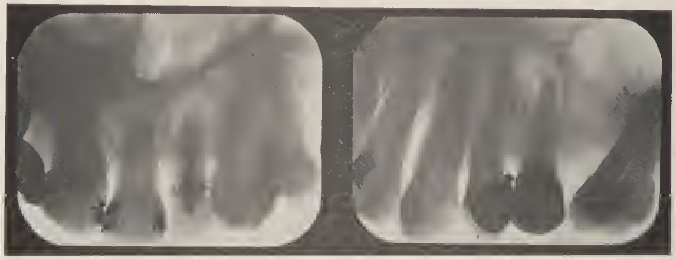


FIG. 123. Pericementoma, or dental granuloma; believed to be the precursors of radicular cysts.

FIG. 124. Common, smaller types of radicular cysts occurring about infected teeth.

animals and in man, and that they become progressively absorbed. Black further holds that the epithelial cells derived from the enamel organ are merely accidental, whereas the epithelial chains of the pericemental membrane are always present and purposeful in function.

Grawitz maintains that the epithelium may be just an ingrowth from the oral mucous membrane through a sinus which subsequently becomes

closed. Such a mechanism is comprehensible in those cases where there is a fistulous opening leading to the mucous membrane surface. We

Fig. 125. Two retained radicular cysts disclosed in a radiographic survey, twelve years after the removal of the teeth. The cuspid between was a normal tooth. The patient was a man 38 years old.

Fig. 126. Retained radicular cyst over lateral incisor, which became infected and began to discharge through the unclosed tooth socket six years after the removal of the tooth.

know, however, that a cyst formation is not always preceded by sinus formation. Some investigators even go so far as to maintain that a cyst

cannot form where a sinus is present. I have found cysts of this nature in the presence of patulous sinuses and also where there was no evidence that a sinus had ever existed.

Fig. 127. Radicular cyst in man 40 years of age. Note the dome-like invagination of the maxillary sinus. The cyst was removed without invading this cavity.

That a connective tissue proliferation forms the initial and basic organization for these sacs is suggested by the fact that, almost invariably, their fibres seem to merge into the texture of the pericemental membrane. They frequently remain attached to the tooth which is removed, and nearly always so where the cyst is carefully dissected out. When a portion of the root which is devoid of cementum and pericemental membrane projects into the cyst cavity, this attachment is present where the denudation of the root terminates.

Clinical findings seem to controvert the theory that pericementomas (granulomas) and their cystic degenerations partake of the nature of neoplasms. That this tissue is the result of productive inflammation and that its probable function is protective, is suggested by the fact that where, with proper treatment, the source of infection has been removed, retrograde changes are observed and in smaller cases even complete obliteration. It would seem that this tissue, having lost its function, is gradually resolved,

and with this progressive process of resorption there is a synchronous regeneration of bone until the entire cavity is filled in with repair tissue. Many become walled off and continue to exist, or even to grow long after

FIG. 128. Radicular cyst in man 38 years of age. This originated with a central incisor which was abscessed some fifteen or sixteen years ago. The cyst was infected and invaginated the nasal cavity and also the maxillary sinus.

FIG. 129. Same case as Fig. 128 from a different angle.

the etiological tooth is removed. (Figs. 125 and 126.) This, however, should never be depended upon for the eradication of these pathological areas. In their clinical course and reaction to treatment, radicular cysts

behave as benign growths. They gradually increase in size by circumferential pressure absorption of the surrounding bone.

I have studied some cases in which progressive growth could be observed by means of periodic radiographic examination. Their enlarge-

FIG. 130. Radicular cyst in upper jaw of man 28 years of age, caused by broken down roots. The cyst sac was closely adherent to, and in parts blended into the lining membrane of the sinus, and was made continuous with that cavity in the operation.

ment appears to be influenced in a measure by the nature of the surrounding osseous structures. It seems that where cancellous bone is more abundant, their growth is more rapid and they attain a larger size. We observe that they are more common and generally attain larger dimensions in the upper jaw. In the proximity of the maxillary sinus they tend to invaginate the contiguous wall of this cavity. (Figs. 127, 128 and 129.) I have seen cases, however, where the cyst became continuous with the maxillary sinus, and the cyst sac was blended with the lining membrane of the antrum. (Figs. 130 and 131.)

Radicular cysts in the mandible may also attain considerable size, and probably grow at first mainly at the expense of the cancellous tissue. The compact bone likewise may become involved and the entire body of the bone attenuated. When the mandibular canal is encroached upon, it is

FIG. 131. Large radicular cyst in a young man 21 years of age. The entire half of one maxilla was involved, and all the teeth posterior to the lateral incisor had to be removed, except the third molar. There was swelling of the face in the cuspid and infra-orbital region, due to the thinning out of the nasal process of the maxillary bone. The cyst must have originated with the first molar, which had a history of abscess and was removed some five or six years ago. The cyst practically occupied the entire maxillary sinus.

FIG. 132. Radicular cyst in woman 35 years of age. The first molar, about which it most likely originated, was removed about fifteen years ago.

Fig. 133. Radicular cyst in a man 45 years of age, which most likely originated with the broken down root. The bicuspids and cuspid were vital teeth and were not involved in the cyst, as would appear from the radiograph. The growth was practically confined to the cancellous tissue and the compact bone appeared intact. The cyst was removed without injuring the teeth.

Fig. 134. Radicular cyst in girl 15 years of age. The outline here is very characteristic and its growth must have been rapid. Note the compressed and deflected inferior dental canal. The inferior dental nerve was outside the cyst sac.

Fig. 135. Radicular cyst in a man aged 45. The part was edentulous for about twelve or fifteen years and the growth caused no disturbing symptoms.

FIG. 136. Dentigerous cyst in a man 25 years of age. This originated about an unerupted third molar and presented all the symptoms which characterize the tardy eruption of third molars. The tooth was removed, but the cyst was entirely overlooked by the oral surgeon who handled the case. As the condition would not heal, radiographs were taken, which disclosed a large cyst, occupying almost the entire ramus, the angle and part of the body of the mandible.

deflected in its course, or it becomes involved in the cyst. (Figs. 132, 133, 134 and 135.) In either instance the inferior dental nerves and vessels are rarely destroyed and they retain their functional integrity. Even in cases where the mandibular canal is destroyed through bone absorption the contents of the same are often found to be outside the cyst sac and

Fig. 137. Illustrates an upper cuspid, and shows the dental follicle surrounding the crown.

if the sac is carefully removed these structures may remain unimpaired. The ramus and the angle of the jaw are also common sites for the formation of cysts. (Fig. 136.)

Clinical Signs and Symptoms of Radicular Cysts.

The development of radicular cysts is invariably chronic and of a slowly progressive nature. As a rule, no disturbing symptoms arise until it becomes infected or some important structure is pressed upon. This in most cases occurs at a stage when the growth has attained considerable size, a large amount of tissue has been destroyed and probably a number of teeth are involved. The bone is greatly thinned out and at these places pressure will elicit a crepitating egg-shell sound. In some instances, chiefly in the infected ones, there are mild periodical disturbing symptoms, with varying periods of remission, which are often misleading.

The fluid contained in radicular cysts may or may not be infected. When not infected it is yellowish straw colored, mucilaginous in consistency and contains cholesterin crystals. The infected contents are more deeply colored, vary from a light amber yellow to a shade of lighter or deeper green, and may be cheesy in substance. This may sometimes appear as coagulated creamy white pus. When the infection is of long

standing, the contents are foul smelling, and if the cyst communicates with the oral cavity it imparts an offensive odor to the breath.

The formation of radicular cysts is always preceded by chronic peri-

FIGS. 138 and 139. Impacted cuspid tooth, showing early tendencies of cystic degeneration.

cemental infections. We find that both the fistulous and non-fistulous apical infections may undergo cystic degeneration. I have seen numerous cases which communicated with the oral cavity through two or more sinuses. Some of these were entirely invisible and could be discovered only when, upon pressure, the cyst contents would exude through them: others were larger and surrounded by exuberant granulation tissue rings. In many instances the overlying mucous membrane appears to be intact and is free from pathological signs, or there is a definite discoloration, varying from a red that is somewhat deeper than the normal shade, to a bluish cyanotic tint. In the examination of the oral cavity such dis-

colored areas, particularly in the vicinity of devitalized or pulpless teeth, should always be regarded with suspicion, and subjected to radiographic examination.

FIG. 140. Impacted cuspid, showing early stage of a cystic degeneration in a young man 18 years of age.

FIG. 141. Dentigerous cyst in a man 38 years of age. The transition of cyst development from conditions like those illustrated in the preceding cases seems quite logical. See Figs. 137, 138, 139 and 140.

Radiographic Examination of Cystic Areas. The radiograph, as a rule, defines a circumscribed clear-cut cavity. With the growth of the cyst and the extension of bone absorption, some of the adjacent teeth may become involved. This tissue invasion is unlimited and progressive in its process. I have seen some cases where all of the teeth of the affected side were involved. While it tends to be confined to the originally affected side, sometimes both sides become involved.

Dentigerous Cysts. Follicular, or dentigerous, cysts develop about malposed, or impacted, or supernumerary teeth. They may grow without an apparent association with dental structures,

FIG. 142. Dentigerous cyst in woman 32 years of age. The cyst membrane was closely attached to the neck of the tooth, while the root was imbedded in the bone. See Fig. 143.

FIG. 143. Photograph of the tooth and sac removed from case illustrated in Fig. 142.

Figs. 144 and 145. Dentigerous cyst in a child 10 years of age. The condition was not noticed until about three or four weeks prior to the consultation. As indicated by the radiograph, a large part of the mandible, extending from the first molar to the incisors of the opposite side, was involved. The cuspid root was partly imbedded in the lower border of the mandible. The cyst must have existed for some years, as the stunted roots of the two bicuspids bore marks of arrested development, rather than pathological absorption. All the teeth within the area were normal and free from disease.

often where all of the teeth are present, in normal position and normally developed.

In the removal of impacted teeth we often find a definite membrane surrounding the crown of the tooth, which adheres to its neck. This membrane is most likely the remnant of the dental follicle and can nearly always be demonstrated by means of the radiograph and can be dissected

FIG. 146. Dentigerous cyst in a young man 18 years of age. The growth was rather more perceptible on the palatal, than on the buccal surface. The patient was suffering from neuralgic pain in this region, which greatly interfered with concentration upon his studies. In its removal, the cyst was found to contain very little fluid and the sac wall was unusually thick. This was closely adherent to the three fourths developed roots of the third molar. The posterior palatine artery, nerve and vein were merged into the texture of the cyst sac, and the bone was fairly hollowed out in this region. All symptoms disappeared after the removal of the cyst and tooth.

out when the tooth is carefully exposed in the process of removal. Clinically, it is found to adhere to the neck of the tooth and presents as a tough connective tissue sac with its surface next to the crown, smooth and velvety. Histological examination shows it to consist of strong bands of fibrous connective tissue having an epithelial lining. A study of Figs. 137, 138, 139, 140 and 141 is very suggestive of the process of cystic degeneration. Fig. 142 gives the radiograph and Fig. 143 the photograph of a dentigerous cyst, which occurred in a woman 32 years of age. The cyst sac is closely attached about the neck of the impacted lower right bicuspid tooth and strongly suggests that its origin lay in the tissues which originally surrounded the crown. The root was found to be normally imbedded in the bone, while the cyst inclosing the crown of the tooth spread out mushroom fashion and was lodged in the surrounding bony cavity. This form of attachment is not always demonstrable. A further study of the cases represented in Figs. 144, 145, 146, 147, 148, 149, 150, 151 and 152 will prove to be quite enlightening as they show the diverse manifestations of these growths and the varied ages at which

FIG. 147. Dentigerous cyst in a girl 14 years of age. The swelling was first noticed about three weeks before this radiograph was taken. The cyst was found to be attached to the misplaced second molar. The third molar was outside the cyst cavity, and the distal root of the first molar was partly absorbed. As the roots of the second molar penetrated through the lower border of the bone, it was feared that, with the removal of this tooth, the bone would collapse, thereby complicating the treatment and probably causing considerable disfigurement. The fine ledge of bone at the upper border was preserved to prevent this. I found later that this was the source of considerable osteogenesis, in the healing of the case.

Fig. 148. Dentigerous cyst in a young man 23 years of age. A rather thick cyst sac was attached to the neck of the malplaced third molar. Note the remarkable attenuation of the bone. In operating upon these cysts, it is desirable to leave as much as possible of this fine, scale-like bone, attached to periosteum, in an undisturbed state. This tissue contains considerable possibilities of bone regeneration, and it is obvious how desirable it is that a considerable amount of new bone should form at this point.

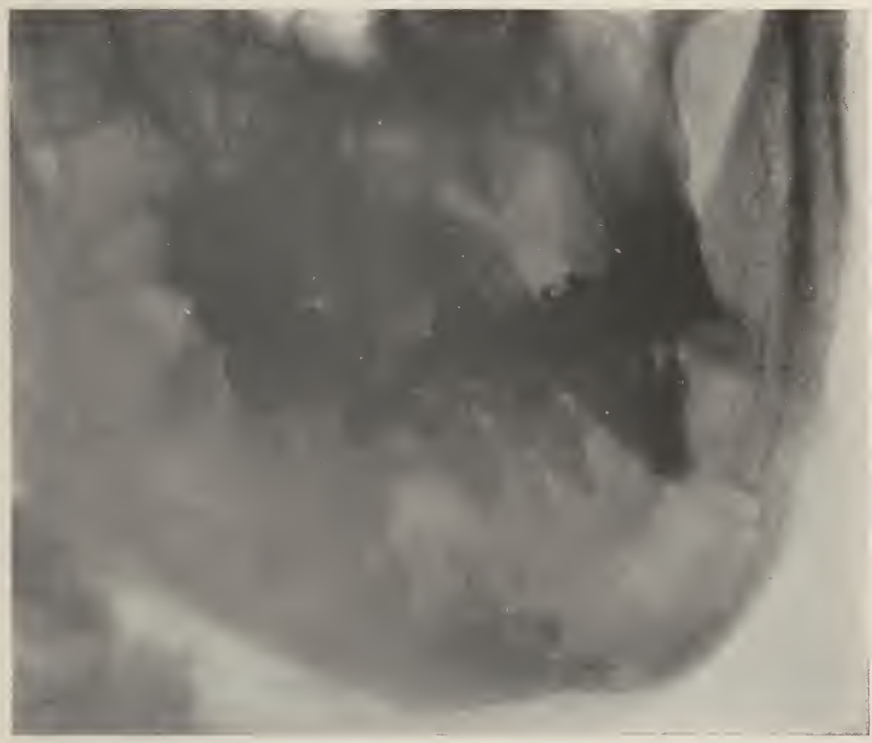


Fig. 149. Dentigerous cyst in a man 34 years of age, caused by impacted cuspid imbedded in the lower border of the bone. All of the teeth, which appear crowned, were free from caries, but, as they were undermined by the cyst, they became loose, and they were erroneously crowned to overcome this. When the cyst was discovered, it had destroyed the entire anterior part of the bone.

Figs. 150 and 151 present an unusually large cystic condition involving both sides of the mandible. This occurred in a man about 34 years of age. All previous history was negative. Wassermann reaction was two plus. The only apparent etiological factor was the impacted cuspid shown in the radiograph. The other teeth present within the cystic area were normal and free from disease. Such extensive involvement of both sides of the mandible is unusual.

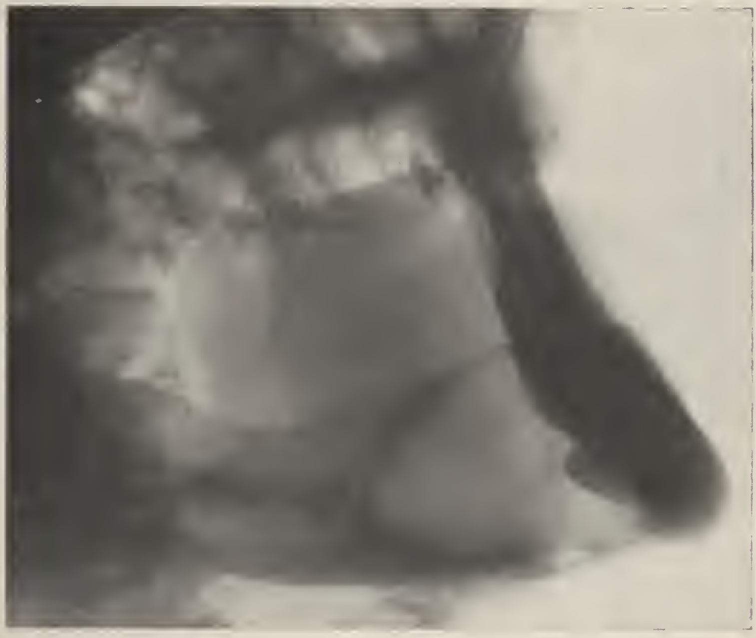


Fig. 152. Dentigerous cyst in a woman 55 years of age. The mouth was edentulous and not until about five years after she commenced to wear her artificial teeth, did symptoms arise.

FIG. 153. Dentigerous cysts in a young woman 24 years of age. The cyst, most likely, developed through aberration of the dentinal papilla of the second bicuspid, as the patient could not recall ever having this tooth extracted and all the other teeth on that side were normal. Note the manner in which the mandibular canal is destroyed throughout the cystic area.

they occur. In cases where there is no association between a tooth and the cyst, or where there is no tooth present, we may assume that they originate from misplaced and unabsorbed epithelial rests, probably remnants of a dental follicle, or an undeveloped supernumerary dental follicle.

FIG. 154. Follicular cyst in young man 22 years of age, invaginating, but not invading the maxillary sinus. All the teeth in this case were normal and entirely free from pathological lesions except the first molar, which was a carious but vital tooth.

(Figs. 153, 154 and 155.) It is frequently observed that an aberration or abnormality in the tooth form or in its development is conducive to cyst formation. (Figs. 156, 157, 158 and 159.)

Clinical Signs and Symptoms of Dentigerous Cysts.

All clinical features of dentigerous cysts are very much like those of the radicular type in which no inflammatory conditions and no infection prevail. Dentigerous cysts are very rarely infected unless an external communication is created by a progressive pathological process, or from adjacent infected structures. They contain usually the characteristic light straw or amber colored fluid, which can readily be withdrawn with an aspirating syringe.

FIG. 155. Dentigerous cyst in a young man 22 years of age. The teeth appeared normal, were free from caries and in normal occlusion. There were no disturbing symptoms until very recently, when a slight swelling appeared at the angle of the jaw, and the third molar became slightly sore upon pressure. It is reasonable to assume that when the third molar had reached this stage of its development, through some reason, there was an arrest of development and a cystic degeneration of the remaining portion of the dentinal papilla. The cyst sac was attached to the third molar, while the second molar roots, though outside of the cyst sac, have undergone pressure absorption.

FIGS. 156 and 157. Dentigerous cyst in a woman 45 years of age. The bridge was worn for about twelve years and the first sign of a swelling occurred about six months prior to applying for treatment. The cyst contained the malformed incisor tooth shown in Fig. 157.

Too much care cannot be exercised in the differential diagnosis between malignant growths and cysts. Sarcomatous growths of the jaws, in their clinical features often simulate cystic conditions. The overlying mucous membrane appears to be free from pathological signs and there is no

Figs. 158 and 159. Dentigerous cyst in a man 28 years of age. There was no complaint until about three years prior to the operation, when swelling in the region appeared, with a slight amount of pain. An incision was made, to relieve the condition, which was repeated three times within this period, before he consulted me. The crown of the lateral incisor was normally shaped and of normal color, but, as indicated by the radiograph, it was twisted in its position. The radiograph showed the abnormal condition of the root surrounded by the cyst area. Upon removal, it was found that the cyst sac was attached to the lateral incisor. The root canal terminated in a funnel-shaped cavity, where the abnormal flattening of the tooth commenced, as shown in the enlarged photograph of the tooth in Fig. 159. The condition suggests a developmental aberration of the tooth which caused a cystic degeneration. All of the other teeth of this patient are faultless and he is a well-developed normal individual.

palpable metastasis to suggest malignancy. When in doubt aspiration should be resorted to. This makes the diagnosis more definite but not always conclusive. Malignant growths may be known by the resistance offered to the penetration of the aspiratory needle and the withdrawal of a scant amount of frothy tissue juice, mixed or colored with blood. (See Malignant Growths.)

In still other cases, an exploratory operation will be the deciding

measure. The overlying mucous membrane is carefully opened or reflected and in case of malignancy, tissues, characteristic of this growth will be disclosed. They appear as a conglomeration of irregularly formed masses showing no purposeful intent in their structural formation. The tissue usually occupies the entire cavity and has a decided tendency to bleed.

Treatment of Radicular and Dentigerous Cysts.

The treatment of cysts is always surgical. There are three different recognized operations that are practiced.

Cyst Operation No. 1.

The first consists of the following steps: incise and raise the mucoperiosteum removing a sufficient amount of the overlying bone to permit of the complete enucleation of the cyst sac. (Figs. 160, 161, 162, 163, 164 and 165.) The mucoperiosteum is restored to its former relationship and sutured into position. Drainage is secured through a small aperture, or between the sutures. The cavity is subsequently dressed until it becomes entirely obliterated. This operation particularly commends itself to us for many reasons. First, the principle of leaving the parts in a normal or nearly normal relationship can be best observed. Second, with the preservation of the mucoperiosteum a remarkable amount of osteogenesis will follow. That this is desirable, particularly in large cysts of the lower jaw, is quite evident.

Cyst Operation No. 2.

In the second operation, the outer wall of the cyst cavity is summarily removed and the mucous membrane may or may not be sutured to the adjacent margins of the cyst membrane. (Figs. 166, 167, 168, 169 and 170.) In this way the cyst is made accessory to the oral cavity, and the cyst membrane and the oral mucosa become one continuous layer. Subsequently the cyst membrane undergoes a modification which renders it similar to that of the oral mucosa. The advantage of this operation is that the technique is simple; that cicatrization is more rapid and that there is no possibility of recurrence. The disadvantages, nevertheless, often outbalance these features. The hollow so created is often unsightly, particularly in the anterior part of the mouth. Prosthetic restoration is difficult and, because of the bulk essential for the filling in of such a cavity, it is unesthetic in appearance. The bone—and this is especially true of the mandible—is left structurally in a weakened condition. Proper hygiene is difficult to maintain, as such a hollow favors the accumulation of food débris and oral exudates.

FIG. 160. Radicular cyst in man 65 years of age. There were no disturbing symptoms but the bone presented a marked bulging in the area. The missing teeth were removed some twenty or twenty-five years ago. The cyst was infected. This case is used to illustrate cyst operation No. 1.

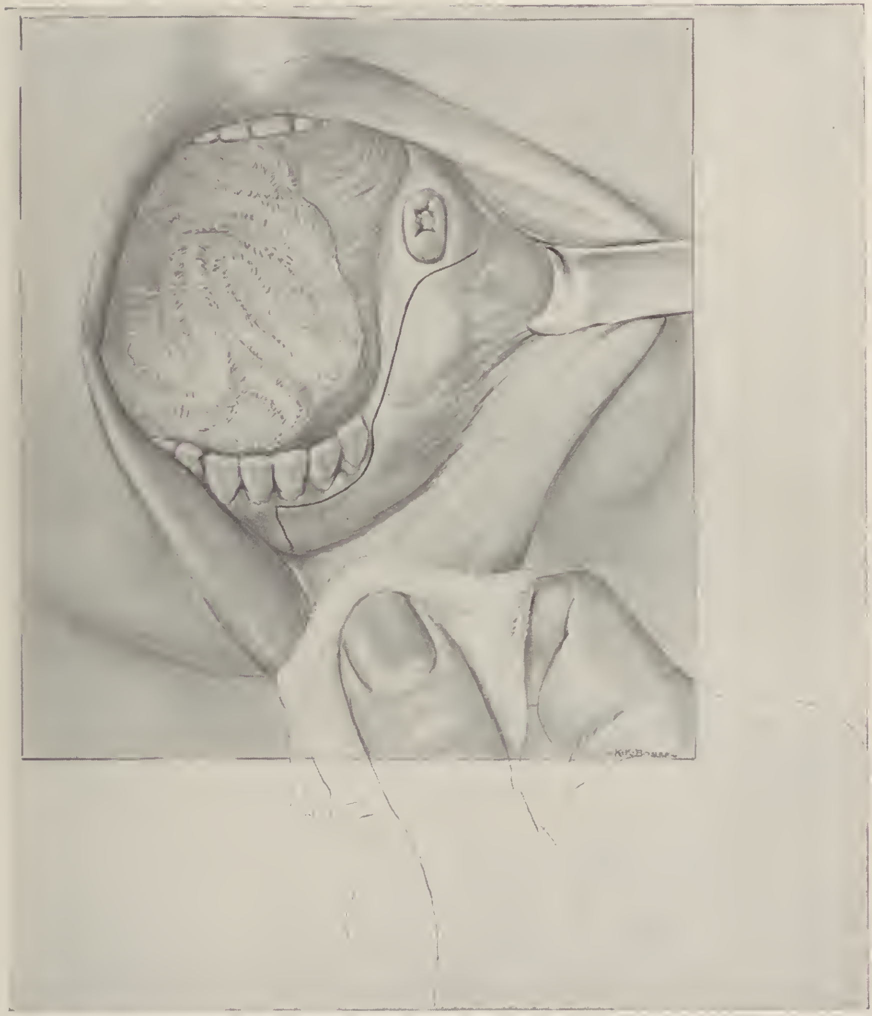


Fig. 161. Shows the line of incision of the mucoperiosteum.

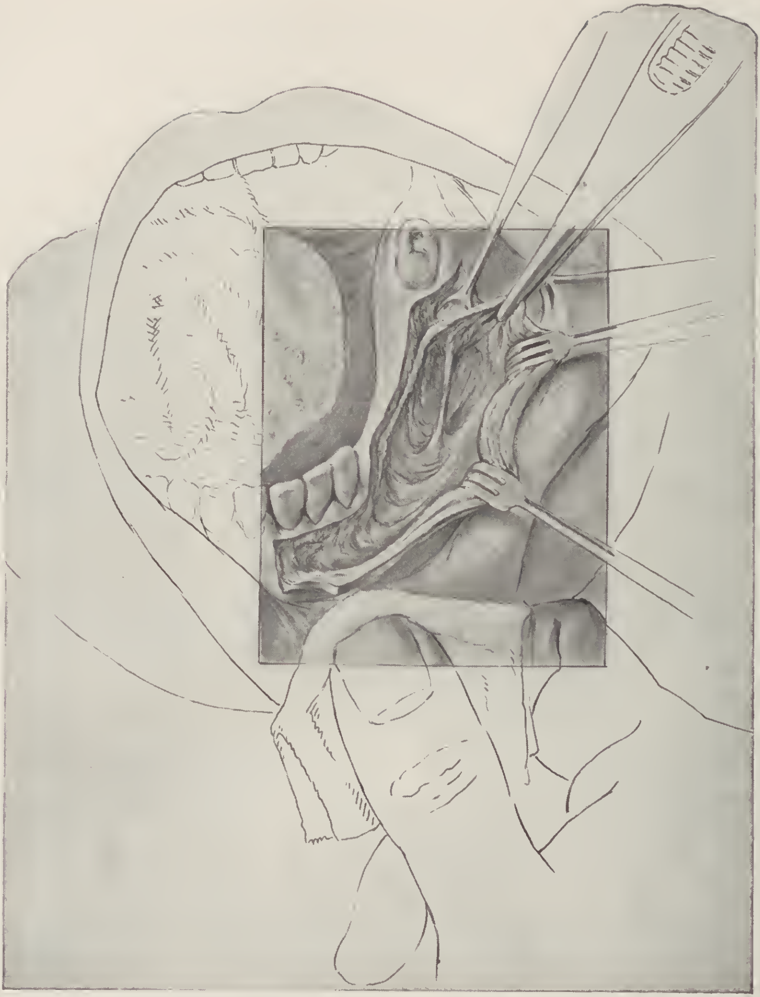


FIG. 162. Shows the second step; the mucoperiosteum is reflected and the collapsed cyst sac is being detached from the bone by blunt dissection.

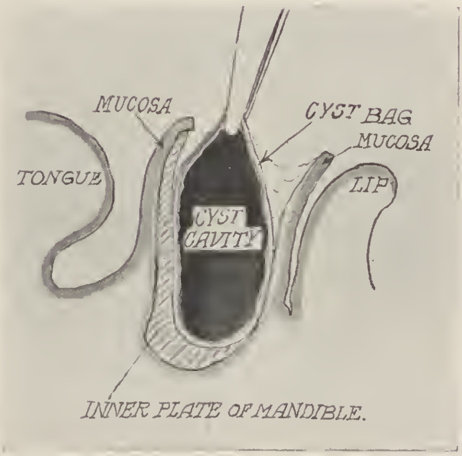


FIG. 163. Diagram showing the relationship of the tissues within the operative field.

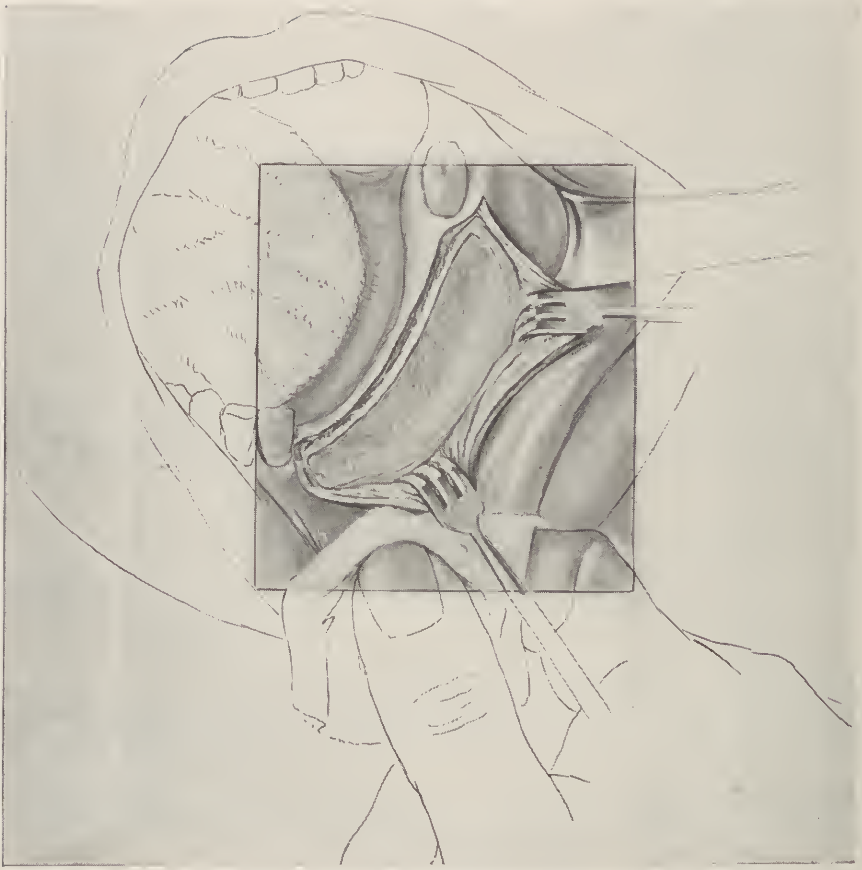


Fig. 164. The third step; the cyst sac and the involved teeth are removed and the bone edges are trimmed. Note the bone ledge left to support the mucous membrane.

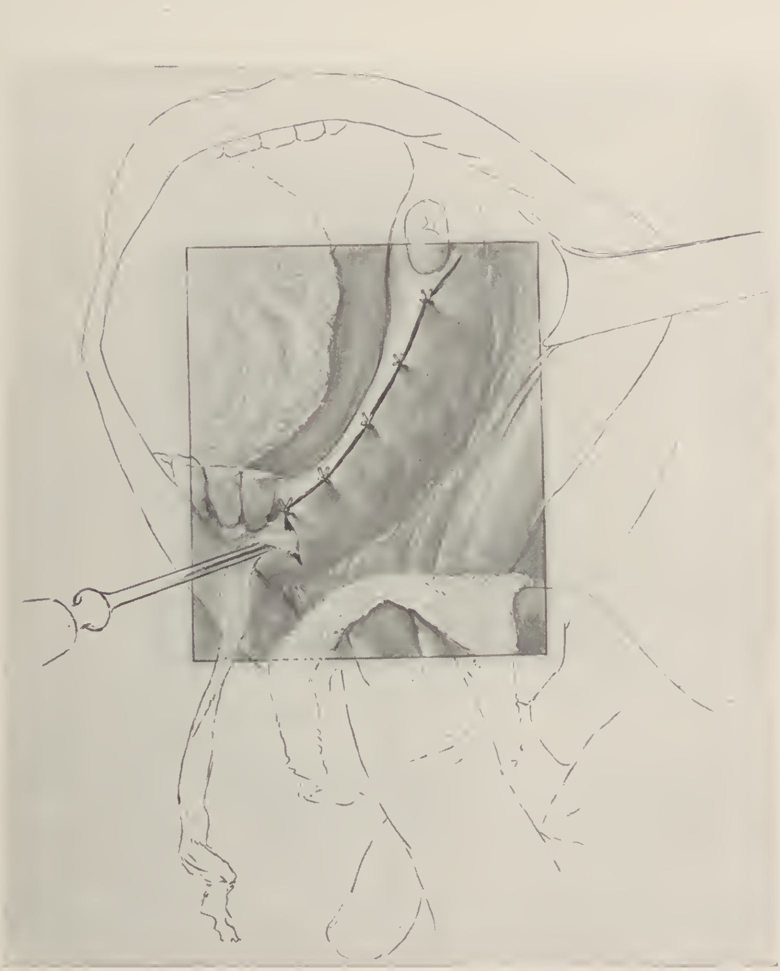


FIG. 165. The final step; the mucoperiosteum sutured into position and a point for irrigation and dressing secured at the anterior part of the wound.

Fig. 166. Drawing, after a practical case, representing a cyst in the bicuspid region; also showing the incision of the mucoperiosteum, in operation No. 2.

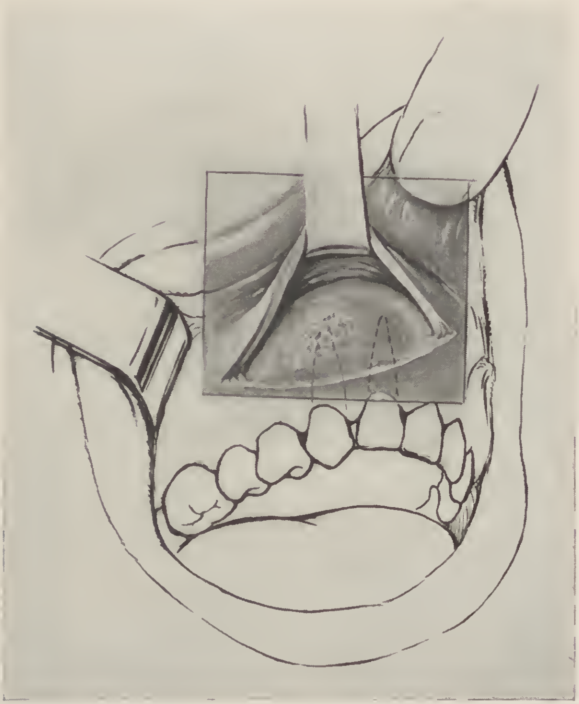


FIG. 167. The mucoperiostal flap raised and the bone exposed.

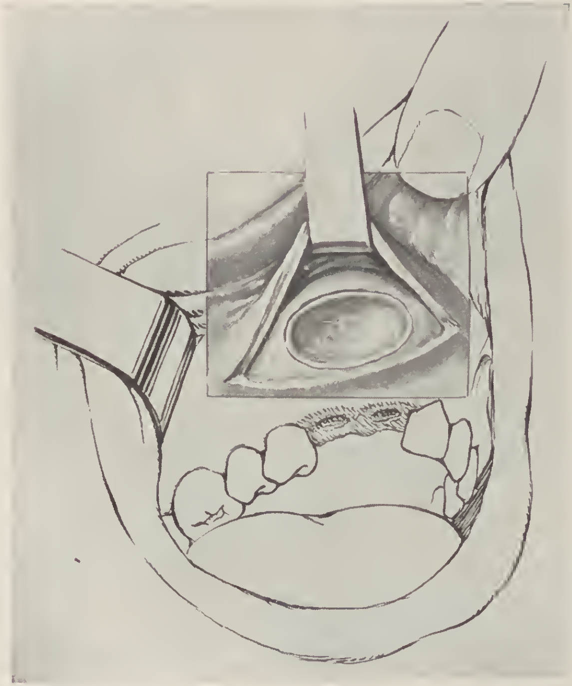


Fig. 168. The outer plate of bone and the outer part of the cyst sac removed, leaving the inner portion of the cyst sac adherent to the bone.

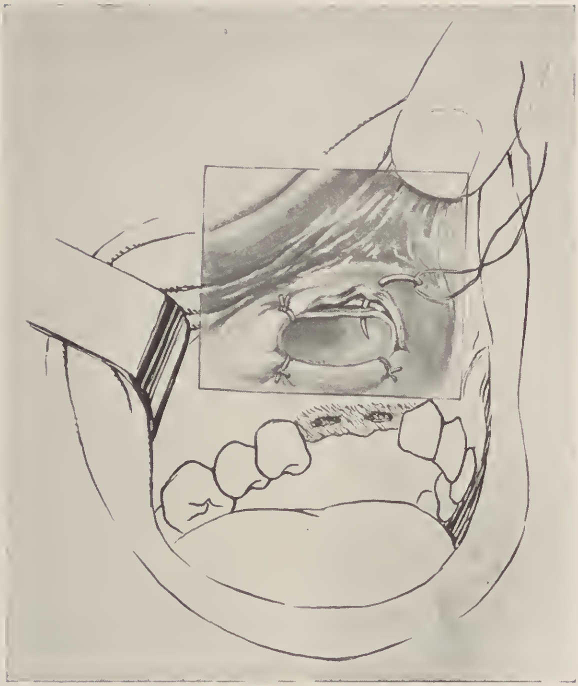


FIG. 169. The oral mucosa is sutured to the cyst, or the tissues forming the external part of the cyst are simply removed, and the cyst cavity is rendered continuous with the oral cavity.

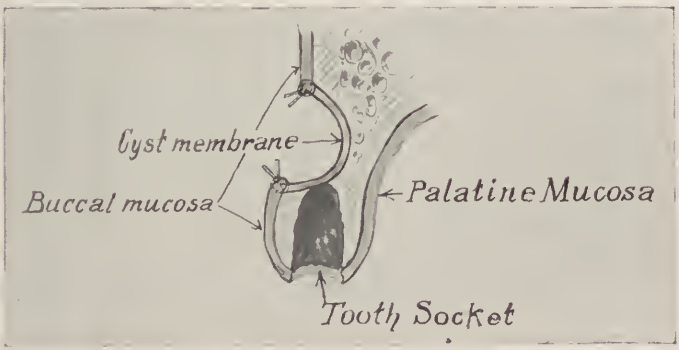


FIG. 170. Diagram of a cross section of the tissues after the operation.

Cyst Operation No. 3.

In the third operation, the outer layer of mucoperiosteum is raised or reflected from the entire extent of the cyst cavity. The external bony plate is removed and trimmed to the outer edges so that the cavity is rendered comparatively shallow. The cyst sac is entirely enucleated and the mucoperiosteal flap is tucked down with gauze dressings to the inner remaining wall of the cyst cavity. (Figs. 171, 172, 173, 174 and 175.) The mucoperiosteum will unite with the bone surface and the bare bony areas eventually become covered with cicatricial tissue and epithelium. The advantage of this operation is that the cicatrization is comparatively rapid, the hollow is somewhat less deep than that left by the second operation, but, like the latter, it leaves the osseous structures in a comparatively weakened condition, as very little bone regeneration can take place under these circumstances.

As a result of experience, I advocate and practice the first operation, whenever it is possible. It is important in this operation that the cyst sac be removed in its entirety. To do this the cyst area must be well exposed to view. Blind curetting through a tooth socket, or through a small aperture, is not conducive to good results. Failure to remove all of the cyst sac may be followed by a recurrence or incomplete healing. While the postoperative treatment here is more protracted, the absence of deformity and the remarkable bone regeneration is a most gratifying compensation for the extra effort.

General Technique of Cyst Operation.

The routine of diagnosis should include two or three radiographs taken from different angles, so that the extent of the involvement may be closely studied. The more obscure areas must later be observed in the operation. Particular attention should be given to the teeth within the area. Sometimes a tooth is just on the border line of a cystic area and, upon testing, it may give evidence of a vital pulp. This examination in itself is not sufficient, as we frequently find, upon exposing this point, that the apical portion of the tooth projects into the cyst cavity. The pulp, therefore, though not entirely devitalized, must be in a pathological state.

Where one or more teeth involved are to be retained, the pulp should be extirpated and the pulp chamber and canals should be thoroughly cleansed and sealed prior to the operation. There are times when this is impossible, because the root canal communicates with the cyst cavity, and the contents of this will continually seep into or evacuate through this channel so that sterility and dryness of the root canal cannot be established. In this event a preliminary operation should be performed. This consists of incising the mucoperiosteum over the apical region of the

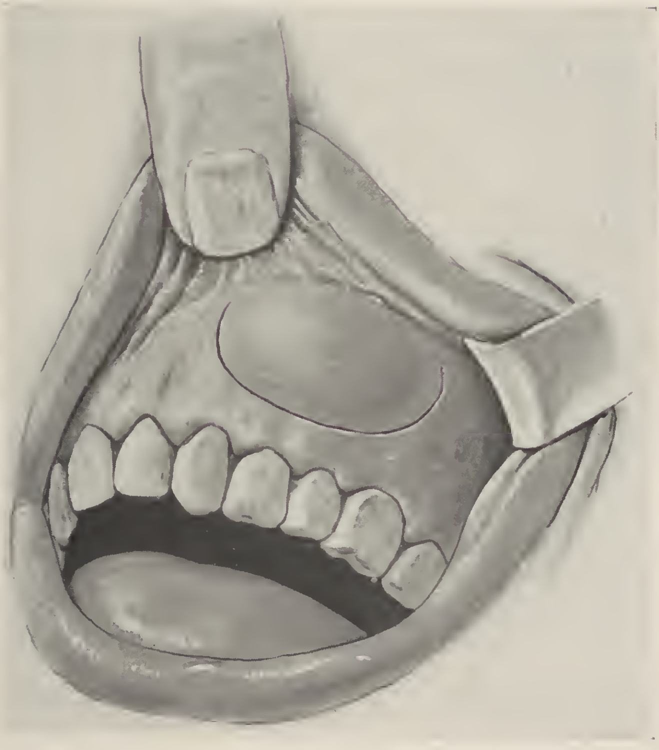


Fig. 171. Shows the line of incision of the mucoperiosteum, in operation No. 3.

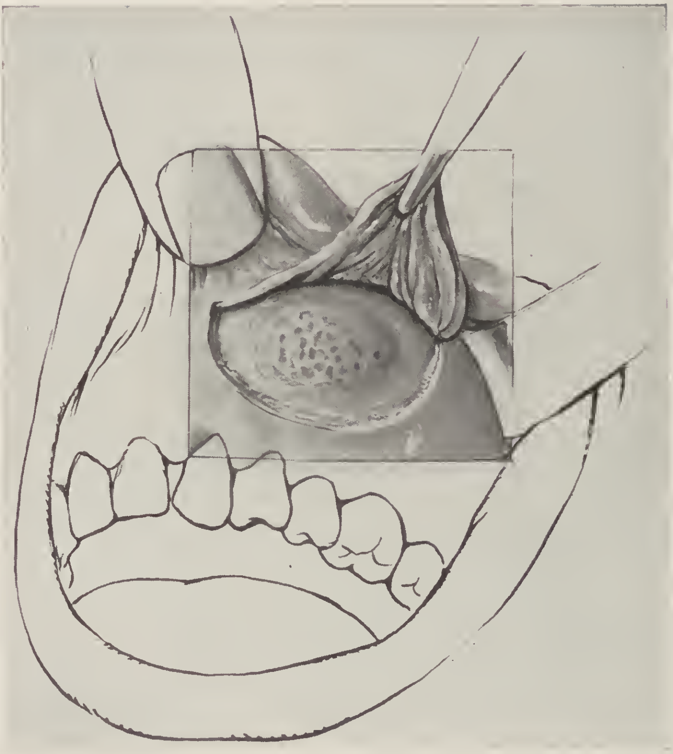


Fig. 172. Shows the second step; the mucoperiosteum raised and the bone exposed.

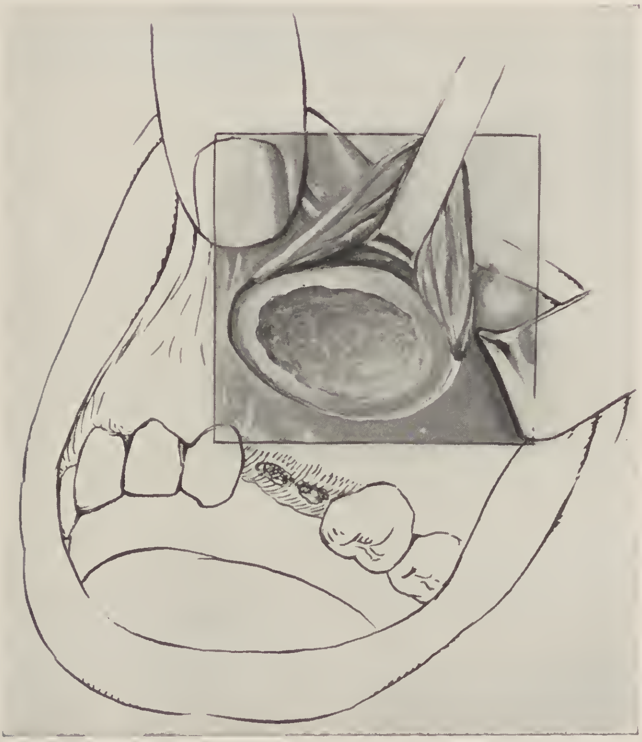


FIG. 173. Shows the third step; the cyst sac entirely enucleated and the bone edges trimmed down so as to render the cavity very shallow; also the teeth involved, removed.

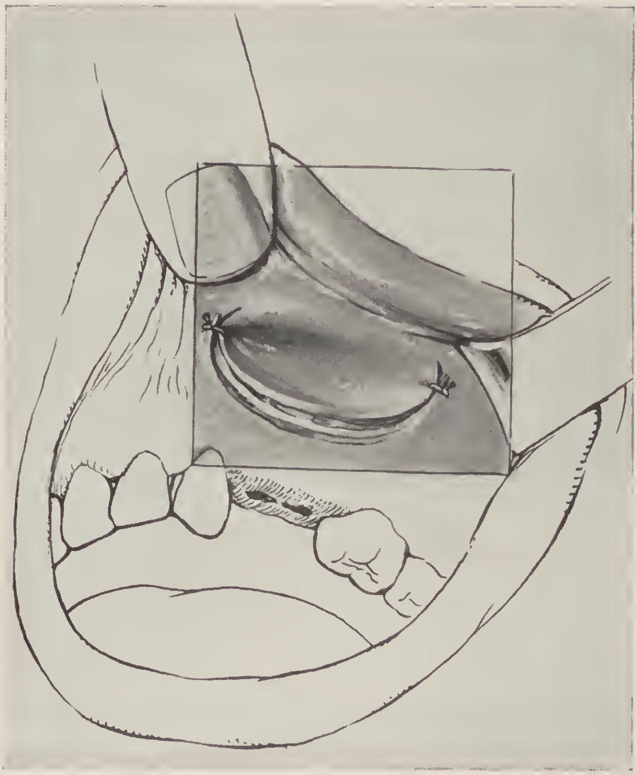


FIG. 174. Shows the final step; the mucoperiosteal flap is held down with two sutures and tucked down into position with the bone surface.

teeth, and opening into the cyst through the bone by means of a chisel, curette, or a surgical bur. The cyst contents are evacuated through this opening and drained until the root canals have been properly taken care of.

The majority of cysts of the oral cavity can be operated upon under local anesthesia and it is much to be preferred to a general anesthetic.

The plan of operation upon cysts consists of the following steps: The oral cavity is swabbed and irrigated with an antiseptic solution, such as

Fig. 175. Diagram showing the mucoperiosteal flap held down by sutures and a gauze pack.

potassium permanganate, boric acid, or normal sterile saline. The area to be operated upon is painted with tincture of iodin.

The line of incision is so planned that a thorough view of the cyst cavity is secured and in the restoration of the mucoperiosteal flap the approximated edges of the wound will rest upon a bone surface.

The mucoperiosteum having been raised, a portion of the external bony wall is removed by means of gouges, chisels and rongeur forceps, until the cyst is rendered accessible and is exposed to view. The sac, if punctured, should be emptied of its contents with sterile swabs and sponges. It is next carefully detached from the bony walls with a blunt periosteotome. This dissection can be performed with facility as the membrane is not strongly adherent to the bone. The attachment is much closer about the teeth and where the sac is in contact with the mucoperiosteum.

Teeth which must be removed should be extracted at once. Of those teeth that have been prepared for retention, the portions of roots project-

ing into the cyst cavity should be amputated. The line of resection should be on a level with the surrounding bone. (See Chapter on root end amputation.) When the cavity has been cleared of all foreign substance and pathological tissue, the bone edges are smoothed by means of a curette; removal of any portion of bone beyond the cyst sac is contra-indicated. In the majority of larger cysts it will be found that, after the removal of the cyst sac, the thinned out portions of the bone still adhere to the mucoperiosteum. Where bone regeneration is desired this lamella of bone should be left intact, as it contains a prolific osteogenetic basis. The cavity is irrigated next, and the mucoperiosteal flap restored and sutured into its former position. Where a tooth is removed, the socket of this will prove to be a convenient point for dressing and irrigation, and in these cases the original incision can be sutured completely and permitted to heal by primary union. Where a tooth socket is not available, a point for irrigation and for introduction of the dressing may be established between the sutures at the lowest point. The dressing of the cavity, which consists of iodoform gauze, is changed at intervals of from 48 to 72 hours, and continued until the cavity is almost entirely filled in. At the renewal of each dressing the cavity should be irrigated with a mild antiseptic solution.

Multilocular Cysts.

Multilocular cysts, or as they are sometimes termed, adamantinoma, or cystic adenoma, are cystic growths of the jaws containing numerous smaller and larger cystic crypts.

These growths are rather uncommon as compared with other cystic degenerations found in the oral cavity or in the jaws. As a rule they are observed in young subjects, between the ages of twenty and forty. They occur more often in the lower than in the upper jaw and about twice as frequently in females as in males.

They are believed to spring from the epithelial rest, or paradental epithelial débris to which Malassez first directed closer attention. He believed that these epithelial rests are derived during fetal life; (1) from the mucous membrane of the fetal jaw; (2) from the epithelial cord of the enamel organ; (3) from the epithelial membrane of the enamel organ. These tissues may also account for the development of some simpler types of cysts, in which no dental factor seems to be present.

In their clinical course, these growths enlarge very slowly, sometimes during a period of years. They are painless unless some adjacent structures such as the infra-orbital, or the inferior dental nerve is pressed

upon, or when they become infected. The cyst cavities may be individual, being divided by a connective tissue stroma or lamellæ of bone, or they may communicate when, through infection, or through absorption the intervening structures are destroyed. Their contents are similar to that found in other cyst cavities. They may be discovered at an early stage of their development and may vary in size from a walnut to an orange, or even larger ones have been reported.

Multilocular cysts are found to be the least malignant of epithelial growths in the jaws and ordinarily they do not metastasize. They are regarded as benign growths, but they have a tendency towards malignant degeneration.

At some stages of their development it is impossible to differentiate clinically between a follicular cyst and an adamantinoma. Even the radiograph is not very definite as to the character of the inner structures. The possibility of sarcomatous growths should always be thought of in making the diagnosis. Some types of sarcomatous growths closely resemble cysts in their clinical and radiographic appearance.

The prognosis, as a rule, is favorable as far as life is concerned. When they attain a large size, the operations are rather disfiguring. It is important that every locule and all parts of the cyst should be extirpated in the removal, as, when these are left in the jaws recurrence of the growth may result.

It may not be out of place here to state that, as all cysts are small at first, they can often be discovered at a very early stage of their development. It should be a part of rational practice to advocate radiographing the jaws of all individuals in the presence of any abnormality about the teeth and jaws.

Mucous Cysts.

Mucous cysts may be considered to be retention cysts, caused by the obstruction of a mucous gland. They may be multiple, but are more often single.

They may occur in almost any part of the oral cavity. The points where they develop most frequently, are the sublingual region, the inner surface of the lower lip, or opposite the bicuspid and molar teeth.

It is very probable that irritation or trauma of the mucous membrane acts as an etiological factor in their formation. I have frequently found them to be associated with accidental, or deliberate external violence, or following biting of the lips or cheek.

They usually appear as spherical bodies lodged in the submucous tissues. As a rule they are small and vary in size from that of a pea to

large bean. When the overlying mucous membrane becomes stretched it may appear slightly discolored. Their presence, however, causes considerable discomfort at times. They grow very slowly and are usually painless in their growth as well as to palpation.

The treatment consists in complete enucleation of the cyst sac. This at times offers a degree of difficulty, as the cyst sac proper is very thin and friable. Where the presence of some remnant of the cyst sac is suspected, it should be cauterized with pure carbolic acid. It is important that in those which occur upon the lip particularly, the mucous membrane should be closely approximated, to prevent an unyielding scar which is a source of discomfort.

CHAPTER XIV.

Ranula.

Ranula is a retention cyst of the salivary glands in the sublingual region. Any one of the salivary glands located in this region, the submaxillary, the sublingual or the glands of Nuhn and Blendin may be affected.

Ranula has been considered as far back as medical knowledge reaches, and derives its name from its assumed resemblance to a frog's belly.

It occurs in both sexes and is not confined to any age. Cases have been reported by others and observed in personal experience in subjects between the ages of six and sixty.

Etiology of Ranula.

There is a diversity of opinion as to the etiology of this growth, even at the present time. Fleishmen claims that it is, commonly, a cystic degeneration of the sublingual bursa. Hanley suggests that it may be due to a congenital defect, or probably to the obstruction of a duct. This latter theory, although quite generally believed, is not truly substantiated by clinical findings. The obstruction of a duct, by mechanical means, is generally accompanied by inflammatory symptoms, whereas, the absence of inflammatory symptoms is one of the characteristics of a ranula, unless it becomes infected. Among the numerous cases which have come under my observation, I have failed to find a direct irritant or a palpable etiologic factor. Lewis observes that the glaring fluid, usually found in a ranula, cannot be saliva. From its general behavior, its tendency to recurrence, its contents, and from the fact that no mechanical obstruction is ever discovered, the conclusion suggests itself that ranula is most likely a cystic degeneration of one or more lobes of the affected gland.

A ranula appears as a roundish, or slightly oval swelling, in the floor of the mouth. (Figs. 176 and 177.) It is usually unilateral and monolocular. In some instances, however, we find that it occupies both sides of the frenum, and that it consists of two or more lobes. The overlying mucous membrane is free from inflammation, except that when large and the tissues become distended it may assume the bluish appearance of a stretched membrane. It is painless and not sensitive upon pressure. It often ruptures without any surgical interference, but usually recurs with

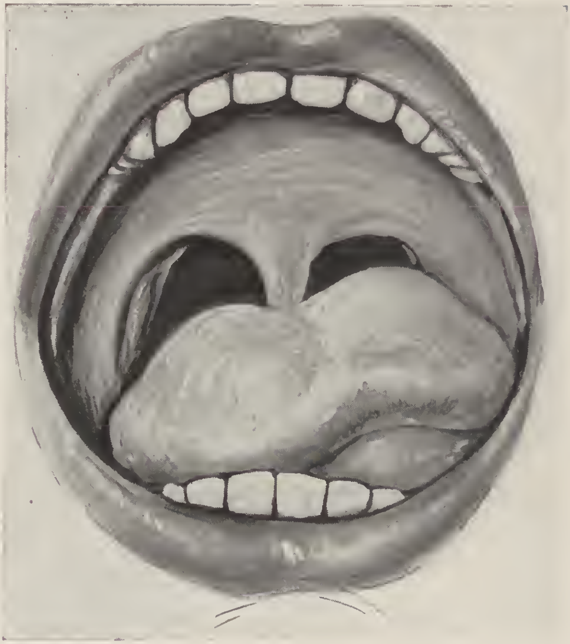


FIG. 176. Schematic presentation of a typical ranula drawn after a practical case.

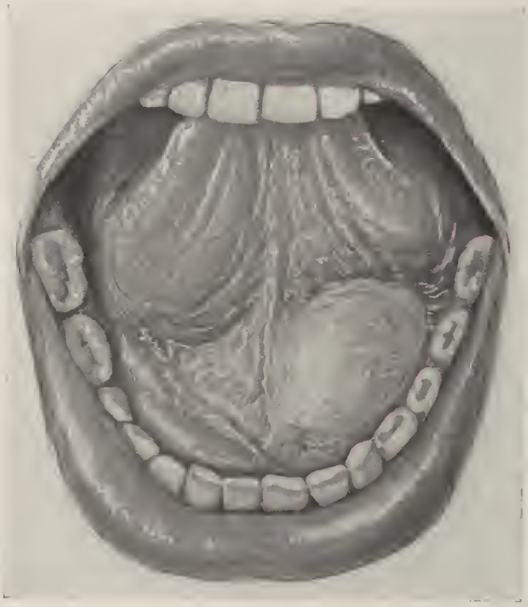


FIG. 177. Same case as Fig. 176 with the tongue raised to the roof of the mouth.

Figs. 178 and 179. Ranula in a woman 34 years of age. This had been incised on several occasions and surface cicatrices prevented it, in some degree, from bulging in the mouth. Note the marked penetration into the sublingual region as indicated by the external swelling in Fig. 178.

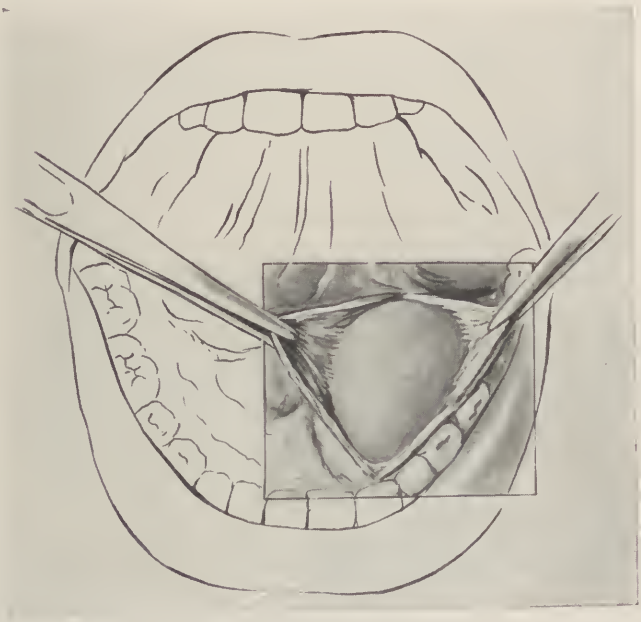


Fig. 180. Ranula, with the overlying mucous membrane dissected away. Note the bulging through of the ranula.

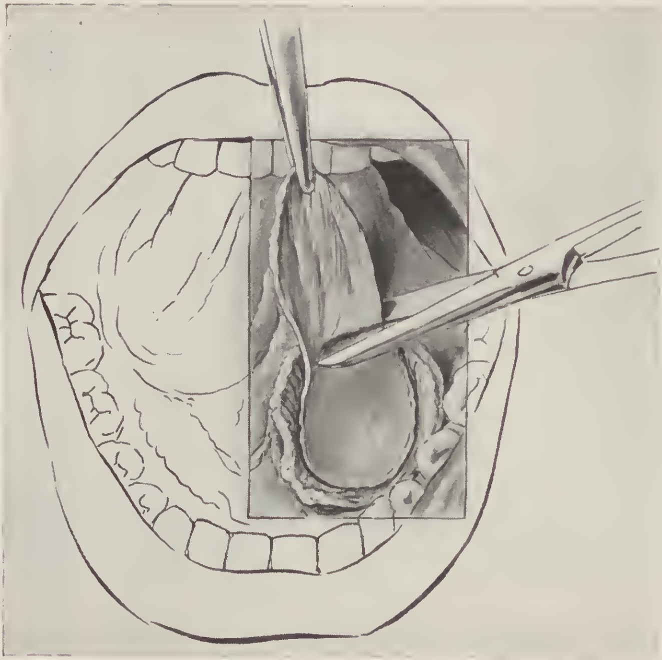


Fig. 181. The exposed part of the ranula sac removed.

Fig. 182. Suturing the pared edges of the sublingual mucous membrane to the lower part of the ranula sac.

the healing of the broken tissues. In some cases, the swelling becomes so large that it is apparent on the under surface of the submaxillary region. (Figs. 178 and 179.) The tongue is displaced to one side or upwards and backwards so that speech and deglutition are impeded.

Treatment of Ranula.

The treatment indicated is, in principle and detail, that required for other cystic conditions. Simple incision evacuates the contents and the condition will temporarily subside, only to recur again. Another mode of treatment used with indifferent success, consists of a seton in the form of a silk ligature, or a silver wire loop, passed through the growth. The fluid contents escape and the seton is left in position until the ranula shrinks and eventually disappears through retrogressive degeneration. This procedure is of somewhat doubtful value and can scarcely be considered as surgical. The following operation has afforded success in the author's hands:

Operation for Ranula.

Local anesthesia is induced, care being taken that the hypodermic needle does not penetrate the ranula. The overlying mucous membrane is incised without carrying the incision into the cyst cavity. This can be avoided only with the greatest care, as the tissues are stretched and very thin. The cyst sac proper soon bulges through the incision and appears like a fine inflated membrane. (Fig. 180.) When a goodly portion of this is dissected out, the exposed part can be excised with a sharp knife or a pair of scissors. (Fig. 181.) The fluid contents, which is usually mucilaginous, clear and ropy in consistency, is thoroughly sponged out. The mucous membrane flaps are inverted and sutured to the denuded sides of the cyst cavity. (Fig. 182.) The cicatrization is very rapid and in my experience there has been no recurrence following this operation.

CHAPTER XV.

A Consideration of Bone Repair and Regeneration.

A large proportion of the diseases and injuries of the face, teeth and jaws involve the bony framework of these regions. Consequently, most operations in this field complicate, to a greater or lesser degree, bone tissue. A clear understanding of the requirements of bone surgery, based upon bone pathology, repair and regeneration, should be a prerequisite therefore in the preparation for this work. A fairly thorough understanding of the processes, with which these problems are directly, or indirectly associated, are helpful in outlining the measures which are indicated in the treatment of the various conditions, as well as in formulating surgical procedures.

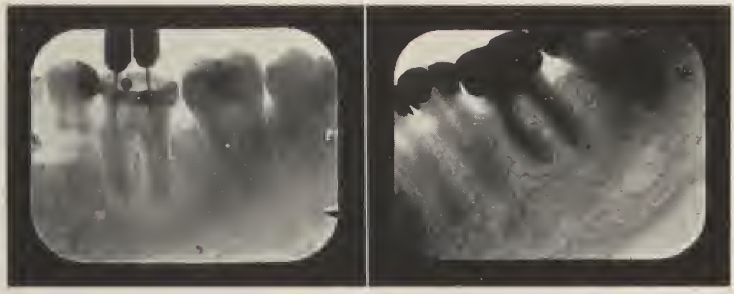
The investigation of the complex processes of bone repair and reproduction has occupied a host of brilliant minds during the past two centuries. Despite the extensive investigations, the problem is not as yet solved with any degree of finality and many of its phases are not clearly understood at the present time.

It would be rather cumbersome to enter into a complete treatment of the subject in this book, but the presentation of an outline of the outstanding theories concerning the subject should be both helpful and of interest.

Theories on Osteogenesis.

Duhamel (1739), a French, nonprofessional investigator, is generally credited with the discovery of the osteogenetic function of the periosteum. Keith states that these investigations were preceded by similar observations and findings made in 1730 by Belchier, an English surgeon. Haller opposed this view, his theory being that the periosteum is merely a limiting membrane, having some nutritional function, and that the bone is deposited by the blood vessels. John Hunter, a disciple of Haller, and an ardent advocate of Haller's theory, discovered that bone growth entails a double process, i.e., bone deposition and bone absorption. Hunter also discovered that the long shafts of bone are produced at the epiphyses and that with this growth the diaphyses are moulded simultaneously. James Syme, a surgeon of Edinburgh, pointed out that scientific physiology and pathology must be combined with clinical observations and experimentation. He succeeded in determining the osteogenetic function of the periosteum by subperiosteal resection of the radius in dogs and the subsequent regenera-

tion of these bones. Goodsir, assistant to Syme and a disciple of Hunter, though he witnessed the experiments of Syme, believed with Haller and Hunter, that bone is deposited by the blood vessels and resorbed by the lymphatics. Goodsir was also probably the first to determine, by means of



Figs. 183 and 184. Marked bone regeneration following the removal of the sources of infection, a gangrenous pulp, from lower first molar. From the collections of Dr. Arthur W. Bark of New York. Fig. 184 shows the bone regeneration one year after treatment and filling of roots.

microscopic examination, that only the cells in close contact with the bone—the osteoblasts—are concerned in bone formation, and that the same type of cells exist in the bone structure. In 1842 Flourens, a French investigator, proved that Duhamel was right, in that the periosteum constantly deposits bone; that Hunter was right in that bone is constantly being absorbed and that bone subsance is therefore in a constant state of flux. Ollier wanted to settle this controversy for himself and concluded from a series of experiments upon rabbits the relative osteogenetic value of the different tissues composing the bone. It was his belief that the periosteum is the chief agent in producing bone; marrow takes a slight part and the bone itself the least share. Sir William Macewen (1877) of Glasgow conducted a series of experiments, principally upon dogs, and his conclusion was that the periosteum is merely a mould, or limiting membrane; that the osteogenetic function of the periosteum is dependent upon the proliferation of osteoblasts from the interior of the bone substance, into the deeper meshes of the periosteum; that this outpouring of the osteoblasts can be induced by irritation, or by inflammatory conditions due to injury or infection. His view was that the principal osteogenetic function is lodged in the bone tissue itself.

At present, despite these diverse opinions coming from these and other research workers in this field, the matter stands as Wetherhill states it:

"The embryologist, the anatomist, the physiologist, the surgeon, and the pathologist agree that the periosteum is not only a source of nutrition for the bone but that it also possesses definite osteogenetic function." There is considerable divergence of opinion as to the exact processes of bone repair, or bone regeneration, but it is fairly agreed upon that it is accomplished by specialized cells, the osteoblasts.

FIG. 185. Radicular cyst caused by infected central incisor in a man 41 years of age. Figs. 186 and 187 were taken six months and one year after the operation.

Osteoblasts. The origin of the osteoblasts is likewise a subject of controversy. Ribbert believes that the osteoblasts are transported to the site of their activity by the blood. No cells which might undergo such a change have been isolated from the blood. In view of this fact Adami, while admitting the possibility of this, does not think it probable.

A summary of the findings of later investigators in this field, such as Axhausen, Lewis, McWilliams, Phemister, Albee and others, leads to the conclusion that all tissues comprising bone are capable of a varied degree of bone regeneration. Of these, Axhausen places the osteogenetic layer of the periosteum first; next in order are the endosteum, the marrow, and lastly the osteogenetic tissues in the bone proper.

Bone Regeneration. In its final analysis, bone reproduction is dependent upon the metaplasia of the young connective tissue cell into an osteofibroblast, which in turn becomes the differentiated osteoblast. Paul divides this process into three stages: (1) decalcification and degeneration of the calcareous material; (2) irritation of some sort, leading to inflammatory proliferation; (3)

FIG. 186. Radiograph of case shown in Fig. 185, soon after the operation.

FIG. 187. Same case as Fig. 185, showing bone regeneration.

ossification of the proliferated young connective tissue. Bunting believes that through metaplasia, the young connective tissue cells are transformed into osteoblasts. Under the influence of the osteoblasts the young connective tissue fibrils become impregnated with calcium salts, thus forming centers of ossification. Layer upon layer of calcium salts is deposited by the osteoblasts, and some of these become walled into the newly formed bone spaces and become bone cells.

The readiness with which bone regeneration takes place after bone has

FIG. 188. Radicular cyst in a man 50 years of age. The molar teeth had been removed about fifteen years before the patient was first seen by me. The condition caused no disturbing symptoms and a small suppurating sinus was discovered by the dentist.

become destroyed, as a result of disease or injury, is dependent upon the following factors: (1) the extent and the nature of the bone destruction; (2) the degree of surgical trauma; (3) the preservation and the treatment of the osteogenetic tissues; (4) the age and the general health of the patient.

Bone Absorption. The process of bone absorption, or resorption, is accomplished by specialized multinucleated cells—the osteoclasts. The origin of these cells is still a matter of controversy. The

Fig. 189 shows the same case as Fig. 188 two years later. The cavity is almost entirely filled in with new osseous tissue. Also note the reconstruction of the oblique ridges of the ramus.

bone marrow contains two types of giant cells: the megakaryocites and the polikaryocites. It is the latter which are believed to be endowed with the specific power of causing osteoclasis. It is believed that these cells are derived from the fusion of the osteoblasts (Kölliker and Howell), the fusion of the matured bone cells (Bredichin), from the lymphoid marrow (Wegener), and the endothelium of the capillaries (Schaeffer). Phemister believes that there are no specific osteoclasts and that a variety of cells possess this absorptive power in common; that most of the bone absorption

FIG. 190. Radicular cyst in a young woman 26 years of age. The teeth of this region were removed some years before, and there were no disturbing symptoms until about three months before the cyst was discovered, when swelling of the face occurred. The cyst seems to have destroyed part of the body and the greater part of the angle and the ramus of the mandible.

is done by the altered fibroblasts and endothelial cells, which, by alteration of function, give rise to giant cells—the osteoclasts.

Alteration in the density of bone may be general, or regional, or local. In the first, there may be a normal absorption of bone, but owing to a perverted calcium metabolism the newly laid down connective tissue does not become calcified. This is seen in such diseases as rickets and osteomalacia. In the second type, the bone absorption is purely local, and as seen about the teeth, or in the jaws, it is due to mechanical, chemical or septic irritation, or to perverted function.

Action of Osteoclasts.

There are various theories, attempting to explain the actual method of the action of the osteoclasts, notably, that the osteoclasts resorb the matrix (Kölliker); that the osteoclasts resorb the matrix and ingest the bone cells

FIG. 191 was taken eighteen months after the operation. Note the remarkable bone reconstruction, also the uniformity and normal appearance of the bone structure.

(Prentis). Prentis also states that there is no evidence to prove how the bone is absorbed, but that, as the osteoclasts are in intimate contact with the bone, which is being resorbed, it may be assumed that they are active agents in this; also that it is probable that the bone is decalcified by an acid formed and digested by the action of an acid and a ferment. The ultimate fate of the osteoclasts is, that they become degenerated and completely destroyed.

Bone Regeneration after Operations.

It should be a matter of interest to know just what becomes of the small and large bone cavities after a cyst has been enucleated and the etiological factor removed, or of some of the gaps resulting from the loss of bone due to necrosis or traumatic injuries. In attempting to determine this, we

must depend in the greatest measure upon our clinical findings, as such facts cannot be disputed by mere theory or speculation.

By following up some of my cases it has been gratifying to note to what extent bone regeneration occurs in the jaws. If we are to trust radiographic evidence, obtained by periodical examination, even extensive cyst cavities become obliterated, with what appears to be granulation tissue at first, which, in the course of time undergoes partial or complete ossification. (See Figs. 183, 184, 185, 186, 187, 188, 189, 190 and 191.) I have also often observed, especially in young children, that where larger segments of bone, as for example the entire ramus, become destroyed by necrosis resulting from infection, the entire part would be reconstructed. (See chapter on Necrosis.) In many instances, the original form of the bone is not reproduced and in still others the gap is only partly spanned over. This is very likely influenced by the violence of the destructive agents, the virulence of the infecting organisms and the recuperative powers of the host.

It is commonly observed that the bone outside a cyst sac appears in the radiograph as well as clinically, to be more dense than the spongiose bone which is indigenous in the part. Our radiographic data suggest that repair here also, as in other processes concerning bone metabolism, is a double activity, that of construction and destruction taking place simultaneously. The apparently denser or so-called sclerotic bone is believed to be diseased by many. McCollum believes that in subacute, or chronic cases of infected bone lesions, the osteoblasts in the vicinity tend to cover up the bone lamellae to prevent the involving of the surrounding bone. The lamellae become thickened and the bone more compact, thus forming eburnation, or sclerosis. This tissue may be regarded therefore as a bone scar, or probably as a barrier, circumscribing a pathological area. Here again, if the radiograph can be taken as evidence, it can be demonstrated that with the removal of the irritating agents, this sclerotic bone which surrounds an infected area, becomes resorbed and is replaced with normal bone, which, in the course of time, blends into apparent uniformity with the continuous structures.

It is exceedingly important in all bone operations in which bone regeneration is desired, that the tissues which are capable of osteogenesis should be preserved. This is particularly true of the periosteum, as I have frequently observed that where the pathological process involved the complete thickness of the bone, or, in the maxilla, when this extended from the buccal to the palatal surface, so that the periosteum was destroyed on both sides, complete ossification did not occur. It is also important that all bone operations should be performed with the utmost observation of

surgical cleanliness. It has been found in bone graft operations, as well as in clinical experience, that acute primary infections are much more violent and destructive in their course than are chronic infections lodged in the bone.

Blood Clot not Dependable.

Some men depend upon the blood clot to fill in bone cavities, which is expected to metamorphose, in the course of time, into bone. Such osteoid transformation is observed and often depended upon, in aseptic fields of bone surgery or bone grafting. Complete reliance cannot be placed, however, upon such a process when operating in the oral cavity, as at best, the blood clot acts merely as temporary scaffolding for the young connective tissues and blood vessels. Even in an aseptic field, in numerous cases, the blood clot breaks down and becomes infected. so that suppuration follows. The oral cavity is constantly infected and with the greatest of care, aseptic operations cannot be carried out, either in the upper or in the lower jaw. Also, with the termination of the operation, the area is flooded with saliva which harbors numerous pathogenic organisms.

I have been often convinced of the fallacy of this method by suturing and closely coaptating the mucosa over a cyst cavity, or over a bone cavity from which a tooth or a foreign body was removed. The lips of the wound were separated two or three days later, at some point between the sutures. Although there were no disturbing nor clinical symptoms, a copious pus discharge followed. When we consider how frequently suppurating conditions are retained in the jaws, often for long periods, or even years, without causing disturbing symptoms, such procedure does not inspire us with a sense of safety.

I have found it to be better practice, therefore, to render these cavities as small and shallow as is consistent with esthetic appearances, and, in the mandible also, with strength desired for function.

At times we observe that larger cavities become obliterated to a degree and at some stage, as though the regenerative powers of the tissues had become exhausted, the process stops. With the use of caustic irritants, or by curetting the superficial surfaces of the wound, proliferation may be again induced. This would argue against the above suggestion. My impression is that in these cases, through faulty approximation of the mucous membrane, through faulty postoperative dressings, or because of a prolific growth of the mucous membrane the wound surface becomes epithelialized. If this newly formed layer of epithelium is destroyed, or surgically removed, repair continues until it is complete.

CHAPTER XVI.

The Removal of Broken-Down and Buried Roots.

Portions of teeth left in the alveolus may be classified as being septic or nonseptic.

The septic ones are parts of diseased teeth and they may be broken down, either by a pathological process, or in the course of their removal. The nonseptic ones are parts of vital teeth and may be broken, either through traumatic injury or in the course of their removal. These also must essentially become infected in time.

There are various views regarding portions of teeth, or roots left in the alveolus. Prior to the better understanding of oral foci of infection it was common practice, especially in European countries, to leave all broken down roots in the jaws, unless they caused trouble, with the idea that the thus preserved alveolar ridges offer better retention for artificial dentures. These were often placed over the unhygienic and diseased conditions so created. Today, this practice has been entirely abandoned by all enlightened dentists and we shall therefore consider merely the isolated cases of roots deeply lodged in the alveolus.

Regarding the fate of these, there are some who believe that smaller portions of roots will, in the course of time, become absorbed, or exfoliated. The first of these conditions does not occur, and the second is essentially accompanied by a pathological process in which a considerable portion of the surrounding bone is destroyed, while probably acting as a focus of infection.

When isolated portions of broken teeth become infected they may act both as septic and as mechanical irritants. The reaction may be inflammatory or clearly neuralgic in nature. To retain any portion of a tooth on these suppositions cannot be considered good practice. The fallacy is even greater when an infected tooth is removed with the intention of eradicating a focus of infection, as the part most frequently diseased is the apex and its surrounding tissue.

The breaking of a tooth in extraction is a common accident and may occur in the hands of any one. The causes for this may be: a peculiar formation of the tooth root; brittleness due to disease, or to dental treat-

ment; excementosis; excessive density of the surrounding bone; faulty technique or faulty manipulation in extraction; unsatisfactory anesthesia, preventing proper surgical procedure.

A portion of a tooth broken off in extraction is often left in the alveolus, not so much because of lack of understanding, but rather because of lack of courage. It seems to be a tradition in the profession, as well

Fig. 192. Portions of roots, such as shown in this radiograph, should never be left in the alveolus, in the hope that they will be absorbed, or exfoliated. They should be removed.

as amongst the laity, that breaking a tooth is an unwarranted and disgraceful accident. Yet we know that, in a percentage of cases, the occurrence is entirely beyond the control of the operator. For this reason a great many men try to conceal the accident by methods which rather aggravate than improve the situation.

It is common practice that in hasty attempts they try to grasp the root by gnawing and tearing away the gum tissue and alveolar structure with forceps. This often results in failure to remove the root; in laceration and mangling of the tissue, which may lead to necrosis; injury to the adjacent teeth; infection; and to intense and prolonged post-operative pain.

A second method, often used, is drilling out the root by means of a surgical bur. The objection to this is, that it is a blind performance and may result either in the removal of too much of the surrounding bone tissue, or a portion of the tooth is left in position.

It is often possible to remove a portion of a root with a curette or an elevator, as for example, when one of the roots of a lower molar remains imbedded in the bone. A Cryer, or a modified Cryer-Winter elevator may be inserted into the empty socket, and the alveolar septum and the root can be thus lifted out.

FIG. 193. Operation for removing broken-down root, such as shown in Fig. 192. The mucous membrane incised.

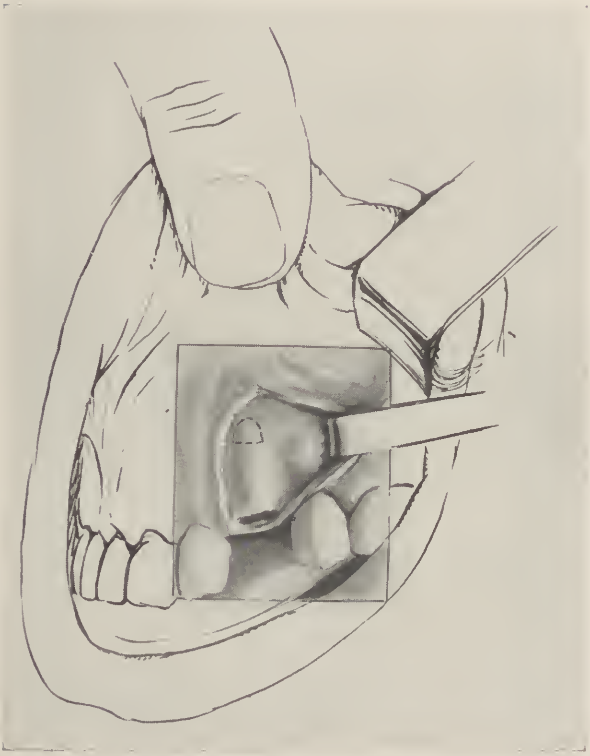


FIG. 194. The mucoperiosteum is turned aside, exposing outer wall of alveolus, which wall is then broken away.

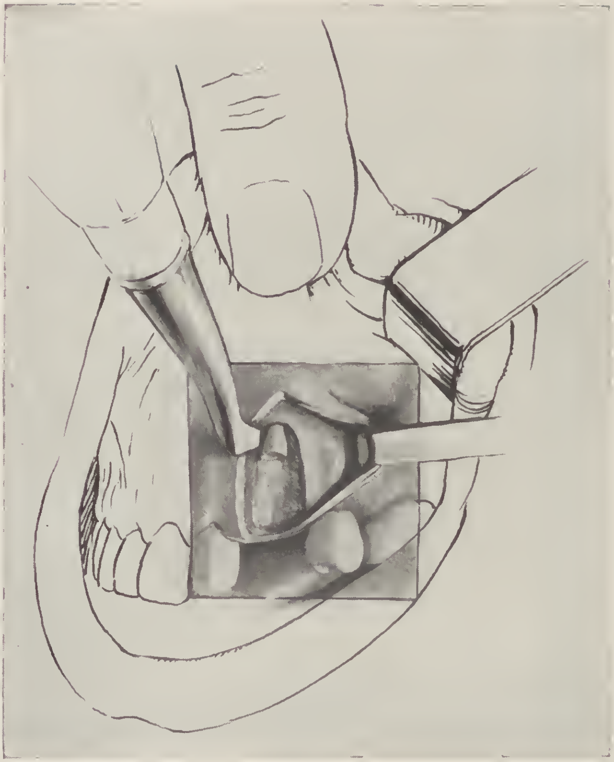


Fig. 195. The root is disclosed and removed with a chisel or elevator.

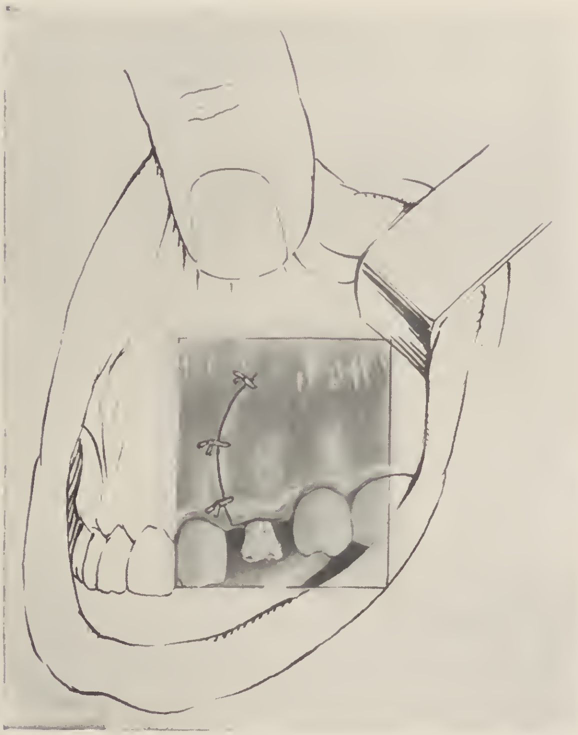


FIG. 196. The mucoperiosteum sutured back into position.

Operation for Removing Broken-down Roots.

Whenever the root is so lodged that, because of its size, position or the nature of the surrounding bone considerable osseous tissue must be removed (Fig. 192), it is more correct to regard it as a foreign body and as such it should be removed by surgical dissection. The mucous membrane is incised anterior or posterior to the tooth socket (Fig. 193) and raised from over the area. (Fig. 194.) The outer wall of the tooth socket is removed next, following the alveolar ridge of the extracted tooth, until the portion of tooth is well exposed to view. This can be done with a surgical bur, or mallet and chisel. The root is dislodged next with a chisel or elevator. (Fig. 195.) The rough bone edges are smoothed off and spicules of bone removed. The wound surface is dusted with an anesthetic powder and the mucoperiosteum sutured into position. (Fig. 196.)

The advantage of this is that the root is removed in its entirety with the least amount of laceration or traumatization of the involved and surrounding tissues.

CHAPTER XVII.

Alveolectomy.

The operation of alveolectomy consists of the excision of a part of the alveolar process. The operation is more often indicated in the upper than in the lower jaw.

The object of the operation is to correct abnormalities and deformities of the alveolar ridges which interfere with the proper adaptation of artificial dentures, or other dental restorations; to remove sharp or projecting edges of the alveolar ridges, following the removal of teeth, which, through pressure and irritation of the overlying mucous membrane, are frequent sources of facial neuralgias, or localized inflammatory conditions and ulcerations; to expose infected areas lodged in the jaws, which may be associated with infected teeth, or which may exist as diffused latent infections; to remove excessive parts of the alveolar ridges which prolong cicatrization and unduly prevent the placing of artificial dentures.

Congenital Outgrowths Inviting Operation.

The abnormalities which indicate the operation may be congenital or acquired. The congenital abnormalities occur, more often, in the upper than in the lower jaw. These are present as bulky masses of bone, most frequently in the molar, or in the condyloid region, and may project lingually, or bucally, or both. While the teeth are in position their presence has no pathological nor surgical significance. With the removal of the teeth, however, these parts rest upon, or are so close to the tissue surfaces of the opposing jaw, that there is no room for a denture; or the lingual or buccal mass of bone may be so large that a plate cannot be fitted over it. In the anterior part of the mouth, where the outline of the upper jaw is considerably larger than that of the lower, it is often helpful to trim the excess down, into better conformity with the lower. There are also cases where the alveolar ridge is too deep and considerably out of proportion with the lip line.

Mention may be made at this point of the congenital osseous excrescences which are not infrequently found to be situated at the median line of the palate. (Fig. 197.) This excrescence is found to be present in females as well as in males. It is sometimes mistaken for a new growth,

or a cyst. The overlying mucous membrane is always normal, unless it is subjected to irritation as in the wearing of a denture. The bone, however, presents no pathological signs. This sometimes offers considerable impediment in the fitting of a denture. In this event the removal of the mass is permissible, but, otherwise, it presents no pathological features and causes no inconvenience to the patient.

Fig. 197. Congenital palatal excrescence, which has no pathological significance.

In the mandible these congenital excrescences more often exist in the internal surface of the bone clear of the median line in the region of the lateral incisors, the cuspids and bicuspids. They present, as unilateral or bilateral enlargements and give one the impression of an osteoma. The overlying mucous membrane is normal, except in the presence of the extension of disease from the gingival tissues. The radiograph taken through the bone is negative, and if one is taken from beneath the chin parallel with the long axis of the teeth the mass appears as a shelf of bone which is normal in its inner structure. Occasionally these growths are observed on the lingual aspect of the lower third, and very rarely the second molar teeth.

FIG. 198. Drawing after a practical case, showing the incision of the gums for alveolectomy.

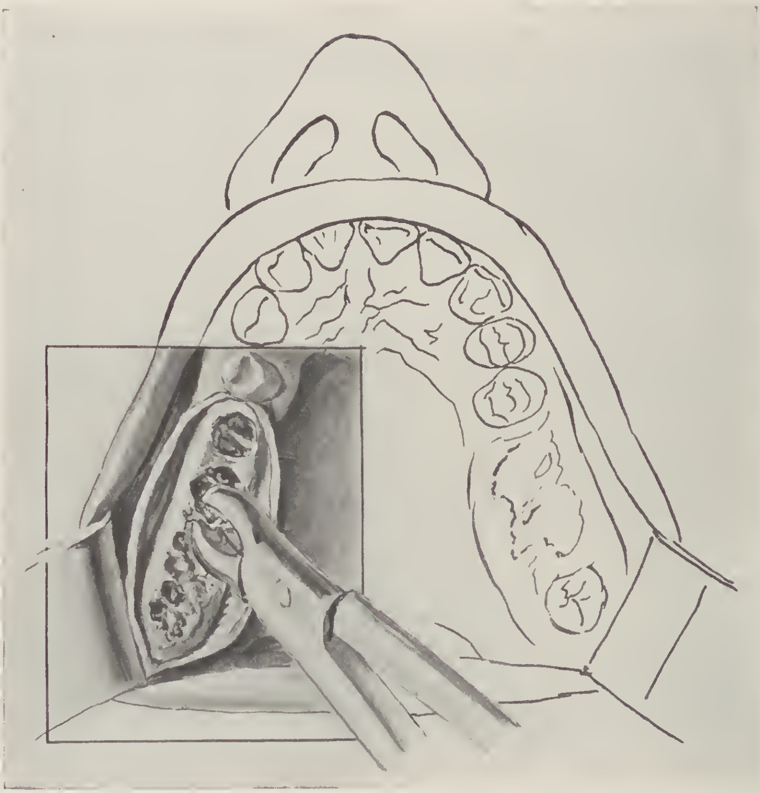


FIG. 199. The mucoperiosteum reflected and the superfluous alveolar process cut away with rongeur forceps.

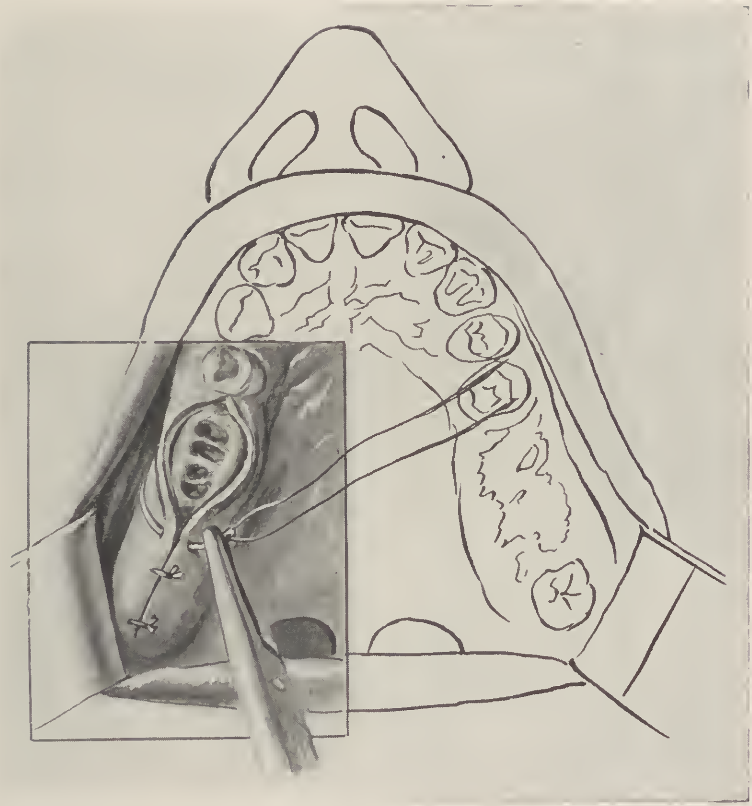


Fig. 200. The bone surfaces smoothed and the soft tissues sutured into position.

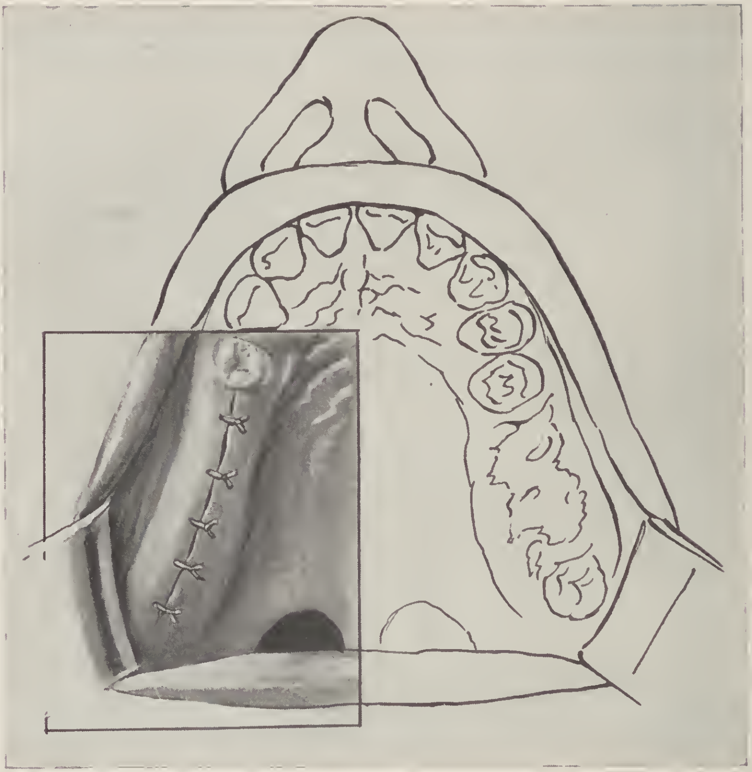


FIG. 201. The correct apposition and suturing of the mucosa over the reduced alveolar ridge.

Acquired Conditions Inviting Operation.

The acquired conditions may exist prior to the removal of the teeth, or only after these have been removed. The removal of teeth at different periods often results in a marked irregularity in the outline of the alveolar ridges. The loss of antagonists after a longer period, may cause a tooth to advance, and proportionate growth of the alveolar process often takes place. This is one of the most frequent acquired causes of irregularity in the outline of the alveolar ridges. Undue laceration in the removal of teeth, or necrosis, often causes irregularities which can be advantageously corrected by alveolectomy. The operation is often indicated, also, where a number of teeth are removed at one time. The ragged ridges can be excised and smoothed, to induce more rapid and more even cicatrization.

With the discovery of some fallacies in the practice of some types of bridge work, there is a considerable tendency in favor of plate prosthesis. In this work many troublesome deformities and irregularities of the alveolar ridges demand correction.

We cannot refrain from pointing out, however, that not unlike other recently popularized methods of practice, this operation has been often abused, or injudiciously performed. Numerous men, who specialize in plate prosthesis, aver that the alveolar ridges are often so mutilated and flattened, that it is impossible to secure retention for their dentures. The operation should be performed only in those cases where there is a decided indication for it, and in such a manner that, when cicatrization ensues, a useful and retentive alveolar ridge is the result.

Technique for Alveolectomy.

Prior to the operation the mouth is thoroughly irrigated; local anesthesia is induced, and the parts to be operated upon are painted with tincture of iodin. If the part is an old deformity, an incision is carried over the center of the ridge and the mucous membrane is reflected, respectively, towards the palate and towards the buccal or labial surface. When the operation is performed at the time of the removal of the teeth, this incision is unnecessary. The gum tissues which ordinarily fill the interdental spaces and bind the buccal and lingual mucosa are divided, or excised (Fig. 198), and the alveolar ridge thoroughly exposed to view. The superfluous portion of the alveolar bone is next cut away with rongeur or bone-cutting forceps (Fig. 199), and when a sufficient amount has been removed, the surface is smoothed with curettes and the soft tissues are brought back into position. (Fig. 200.) The superfluous parts of mucous membrane are trimmed until the edges approximate, fitting snugly over the newly-formed alveolar ridge. These are sutured with horsehair or silk either by the interrupted or the continuous method.

The palatal mucous membrane is quite thick and, as a rule, unyielding; if in the approximation, the buccal flap has to be brought over considerably towards the palate this produces a slanting surface. The inclined plane which thus results makes the retention of a prosthetic appliance very difficult. This condition can be overcome by nicking the palatal mucous membrane on the surface next to the bone. Care must be taken that the edges of the mucous membrane flaps are so approximated that the pared edges are brought into direct apposition without undue pressure or traction, so that they meet at the center of the ridge with no overlapping. (Fig. 201.)

In the absence of infection or sloughing, these conditions heal by primary union and the sutures may be removed in four or five days. The postoperative treatment consists of thorough irrigation with a mild antiseptic and deodorizing solution, such as boric acid or normal saline, and the maintenance of cleanliness of the oral cavity. The application of irritants or escharotics to the wound edges is superfluous.

CHAPTER XVIII.

Impacted Teeth.

Teeth which, in the aggregate, are designated as "impacted teeth," can more properly be classified under three general headings: (1) impacted teeth; (2) malposed teeth; (3) unerupted teeth.

Impacted Teeth. Impacted teeth are those which, through an impediment in their eruption, fail to occupy their intended position in the alveolus and in the arch. Such impediment may lodge in some environmental obstacle, or in abnormal development and faulty eruption inherent in the impacted tooth itself. (Fig. 202.)

Malposed Teeth. Malposed teeth are those which, in the absence of an apparent obstacle, through some obscure ontogenetic abnormality in the individual, or an abnormality in the development of these teeth, assume a faulty position in the alveolus and in the arch. (Figs. 203, 204, 205 and 206.)

Fig. 203 shows a malposed cuspid (commonly called impacted).

Fig. 204 shows two malposed (impacted) cuspids and a second bicuspid in a young woman 25 years of age. Note the retained deciduous cuspids and the ample space which these teeth should have occupied. They could scarcely be called impacted in the true sense of the term.

Fig. 205.—Complete and normal formation of upper and lower third molars in a young woman 21 years of age. The teeth are malposed and unerupted, though there does not seem to be outer cause to prevent their eruption. All of the other teeth were normal in their formation and are normally occluding.

Fig. 206.—Malposed unerupted third molar in man 24 years of age. The tooth is not impacted, is fully formed and has sufficient space in the jaw.

Unerupted Teeth. Unerupted teeth are those which are partly or fully formed, normally developed and normally placed, and, though there is no apparent environmental obstacle, they fail to advance through the mucosa and into occlusion. (Fig. 207 and 208.)

Fig. 207.—Two unerupted third molars in a man 22 years of age. There was no discernible abnormality about his jaws or teeth to account

Fig. 202. Impacted lower molars.

Fig. 203. Malposed cuspid; commonly called impacted.

Fig. 204. Malposed cuspids and second bicuspid in one mouth.

FIG. 205. Malposed, unerupted upper and lower third molars. No reason for non-eruption is evident.

FIG. 206. Malposed, unerupted lower molar. Similar to Fig. 205.

FIGS. 207 and 208. Unerupted third molars. No cause apparent.

for the condition. The lower one is not completely formed and is slightly impacted.

Fig. 208.—Unerupted tooth in a woman 52 years of age. Some of the teeth in this case were missing, but those present were in normal occlu-

Fig. 209. Early stage of calcification of third molar; normal position.

Fig. 210. Early stage of calcification of third molar; slightly crowded.

sion. The third molar illustrated here can scarcely be called impacted. It is normally formed and in normal position. The occlusal surface was covered merely by the mucoperiosteum.

These distinctions are helpful in the study of the nature and causes of impactions, but they are of small significance so far as symptomatology

and treatment are concerned. We shall, therefore, in this chapter designate all conditions described above merely as impaction.

Fig. 211. Later stage of calcification of third molar; normal.

Fig. 212. Similar to Fig. 211, but with mesiobuccal inclination.

It is to be understood that almost any combination of these conditions may exist; for example: a tooth may be malposed and impacted; it may be

malposed, impacted, and unerupted; it may be impacted and unerupted; and other combinations may occur.

FIG. 213. Early evidence of impaction of third molar.

FIG. 214. Early evidence of impaction of third molar. Also malposition of bicuspid.

Etiology of Impaction of Teeth.

Different theories have been advanced to explain the abnormality of the impaction of teeth and their anomalies. All of these, however, seem inadequate to explain the varied conditions met and often fail to render more comprehensible our clinical findings.

The most frequently advanced causes for impaction may be classified into local and general.

Local Causes of Impaction.

The local causes are: (1) irregularity in the position and pressure of an adjacent tooth; (2) the density of the overlying or surrounding bone; (3) inflammation and density of the overlying mucous membrane; (4)

lack of space due to under-developed condition of jaws; (5) unduly long retention of the temporary teeth; (6) premature loss of the temporary

FIG. 215. Early evidence of malposition of third molar.

FIG. 216. Early evidence of malposition of third molar.

teeth; (7) acquired diseases, such as necrosis due to infection or abscesses; (8) inflammatory changes in the bone due to exanthematous diseases in children.

We find, however, numerous impactions where none of these conditions appear to exist. While environmental influences may operate in a great measure in the causation of impactions, upon close study of the sub-

Fig. 217. The case of a young man 26 years of age who had an impacted third molar removed, and its mesial root end was forced into the inferior dental canal.

Fig. 218. Impacted lower third molar in a young woman 27 years of age. In the removal of this tooth the second molar must be undermined, or probably injured. Also, because of its deep-seated position, the bone would have to be greatly weakened if removal were attempted from the side, or from underneath.

Fig. 219. Illustrates cases in which the second molars should be removed because of disease.

ject we are forcibly impressed with the fact that there are other etiologic factors which must have an ontogenetic significance.

In radiographing a number of young children between the ages of 6 and 12, I observed that the lower third molars, which are the most frequently impacted, show rather early signs of a tendency to malposition. Radiographs show that, prior to calcification, there is variation in the posi-

tion of the dental follicles. Some are situated quite deep in the bone, while others, in children of the same age, are close to, or in contact with the mucoperiosteum. A variation in the two sides of the same child may also be observed. Again, where calcification of the cusps has just begun, even at this early stage, they show signs of a tendency towards malposition. Some have their occlusal surfaces pointing upwards, some buccally

Fig. 220. Impacted cuspid in which the removal of the first bicuspid is indicated because of disease.

Fig. 221. Absorption of distal root of second molar in a man 29 years of age. Both teeth were necessarily removed.

or lingually; others face directly towards the tooth in front of them or backward towards the ramus. These early manifestations may not be absolutely convincing, but they strongly suggest that the causes of impaction are more complex than we have suspected and that they must be sought in another direction. The subject would offer a very interesting field of research for men, particularly orthodontists, whose relations with children permit observation through a series of years, during the ages of the formation and eruption of the teeth until the period when this is completed. See series of radiographs, Figs. 209 to 216, inclusive.

Fig. 209.—Radiograph of a child about 8 or 9 years of age. Note the early stage of calcification of the cusps of the third molars and their position. This most likely will erupt normally.

Fig. 210.—Radiograph of a child about 8 or 9 years of age. Note the similar degree of calcification of the third molar. There seems to be a slight crowding and a mesiobuccal inclination of the cusps.

Fig. 211.—Radiograph of a child about 8 or 9 years of age. A somewhat more advanced calcification of the tooth more deeply lodged in the bone. A normal eruption may be expected.

Fig. 222. Impacted lower third molars having mesial inclination.

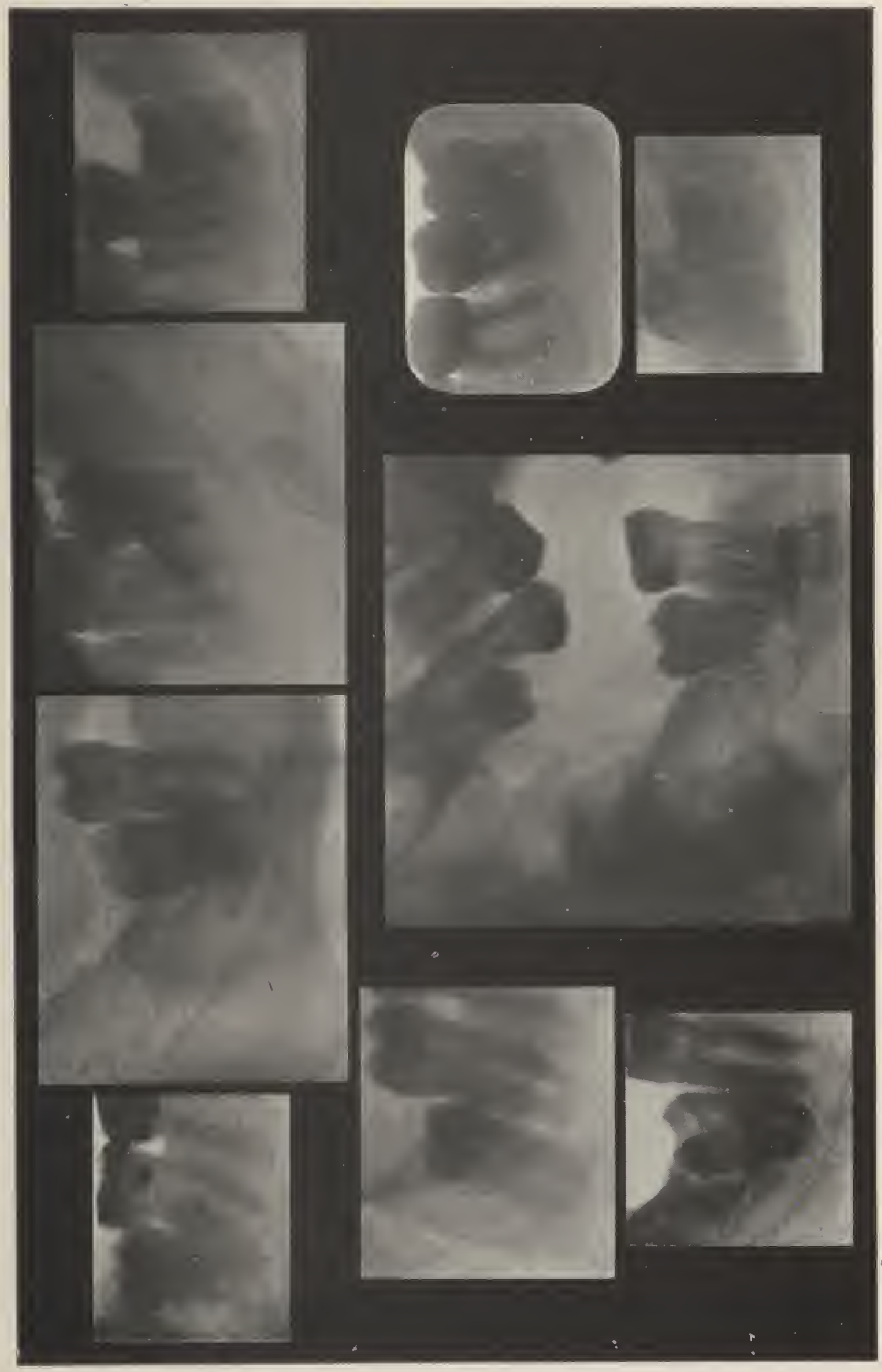


FIG. 223. Impacted lower molars in upright position.

Fig. 212.—About the same degree of calcification in a child about 8 or 9 years of age. There is no impaction, but the tooth is covered with quite a thick layer of bone and has a slight mesiobuccal inclination.

Fig. 213.—A somewhat more advanced calcification in a child of 9 or 10. Note the fairly normal position of the cusps of the third molar, yet a tendency towards impaction.

Fig. 214.—Radiograph of a boy about 10 years of age. Note the decided tendency toward malposition of the third molar; also torsion and malposition of the second bicuspid.

Fig. 215.—Radiograph of a child about 11 years of age. There is no lack of space nor crowding of these teeth, all of which have erupted, but the third molar shows decided tendency towards malposition.

Fig. 216.—Shows decided signs of impaction of the third molar and malposition (torsion) of the second bicuspid.

Systemic Causes of Impaction. The systemic causes of impaction may be prenatal or postnatal. The prenatal causes are heredity, miscegenation, syphilis and tuberculosis, malnutrition, debilitating modes of living or diseases in the parent which may influence the development of the offspring.

Postnatal influences are all conditions which may interfere with the development of the child, such as malnutrition, rickets, anemia, hereditary syphilis, tuberculosis and the exanthematous diseases: diseases of the jaws and the surrounding tissues; the lack of space in under-developed jaws. The impactions which might be attributed to the exanthemata can be explained by the generalized bony changes that occur. If an inflammatory condensation osteitis should happen to localize in the jaw it is readily seen that impaction may result.

Any tooth in the human mouth may be impacted in the terms of the above classification and examples of all are observed from time to time. Though I am unable to give accurate statistics, I shall venture to proffer my impressions as to the frequency of impaction of the various teeth.

The most frequently impacted teeth are: (1) The lower third molars; (2) the upper third molars; (3) upper cuspids; (4) lower cuspids; (5) upper bicuspids; (6) lower bicuspids; (7) upper lateral incisors; and (8) upper centrals. The upper and lower first and second molars are very rarely impacted.

Complications. The complications arising from impacted teeth may be classed under two general headings. First, conditions accompanied by palpable inflammatory reactions and tissue changes; second, neuralgias and neuroses, which may be reflected not only

to the areas of distribution of the nerve involved and through the associated nerve plexuses, but even to remote regions.

The inflammatory conditions caused by impacted teeth may be acute or chronic. These are often accompanied by tissue deterioration or destruction. The most common complications of the inflammatory type are: acute or chronic alveolar abscess; chronic suppurative osteitis; osteomyelitis; necrosis; cysts; pathologic absorption of the adjacent teeth. The tissue destruction in the above enumerated conditions may be slight, or so extensive that important structures in their region, as the maxillary sinus, the inferior dental canal, or the nasal cavities are infringed upon or actually invaded.

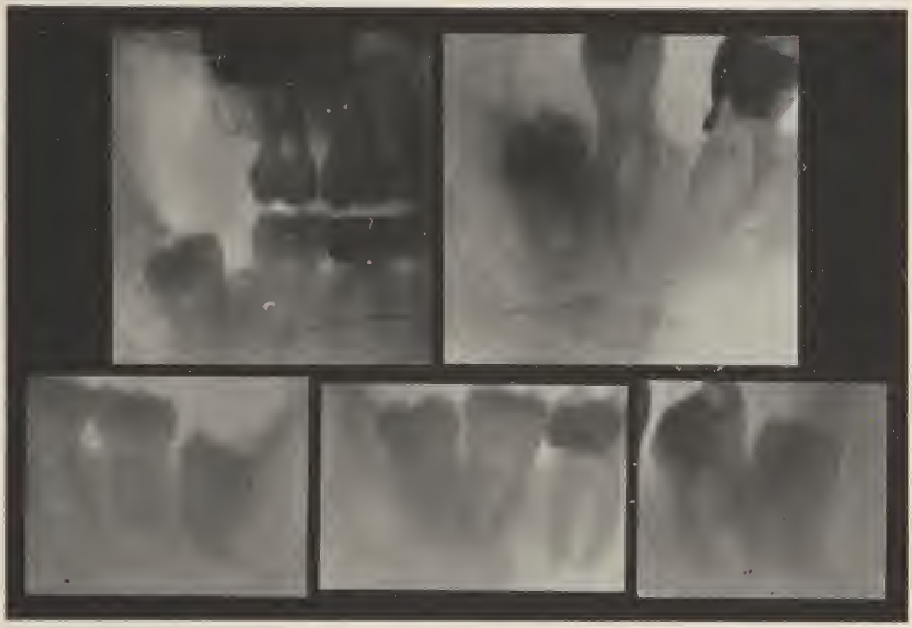


Fig. 224. Impacted lower third molars having distal inclination.

In the second class are those in which the syndromes manifest as purely nervous disturbances, with no palpable inflammatory symptoms. The pain in these cases may be slight, or very severe and often excruciating. This may be intermittent, periodical or constant. It may be localized, but is quite often reflected through the distribution of both dental branches of the trifacial nerve.

Neuralgic Reflexes from Impacted Teeth.

The citation of the following case in point will illustrate the complex neuralgic conditions which may arise as a result of impacted teeth.

Miss C. M., 22 years of age; American; no occupation. Family history, physical examinations and laboratory tests negative. At the age of fourteen she developed neuralgic pains on both sides of her head. The pain was more severe on the right side and was referred to the ear and the mastoid region. Upon examination the ear was found to be normal and, except for the subjective symptoms, there was nothing to suggest mastoiditis. The right mastoid was opened and in the operation was found to be normal. This operation was performed at the age of sixteen, two years after the onset of the complaint. There was a mild but not complete remission following this, the pain being less intense and the aggravated attacks less frequent. At the age of about eighteen the pains became more intense and the patient commenced to suffer from severe headaches, spells of dizziness, and impaired vision. The examination of the eyes proved negative, but glasses were prescribed. These did not seem to help the condition very much. At the age of twenty the left mastoid was opened and this was also found to be normal. This also failed to relieve the patient and she was treated with various sedatives and anodynes.

In November, 1915, when the writer first saw the patient she was suffering with intense pain on both sides of the head. The pain was reflected to the ears, the temporal, the parietal, the occipital and the cervical regions. She was also suffering with intense, uncontrollable headaches, spells of vertigo, and blurred vision. She could not concentrate on anything, and was unable to turn her head, very much like those suffering from wry neck. Upon radiographic examination of the head and teeth three impacted third molars and two supernumerary teeth were found; two upper third molars and a supernumerary tooth on each side in this region and one lower right third molar, completely buried in the bone. The upper third molar on the left side was imbedded between the roots of the second molar and lay transversely in the maxilla with the roots pointing toward the palate and the crown buccally. As the muscles of the neck seemed more affected on the left side, the impacted third molar, the second molar and also the supernumerary tooth were removed. The almost immediate relief following this operation was truly remarkable. The pain seemed to have entirely abated on this side and within forty-eight hours, except the expected post-operative soreness at the site of operation, the patient was practically free from pain and could turn her head with perfect freedom. The other impacted teeth were subsequently removed and within three months she was

entirely free from all complaints. There was at no time any inflammatory condition nor symptom in any one of these regions.

The mechanism of these neuralgic phenomena is obscure. It is probable that, owing to its incorrect position, the nerve supply of the tooth proper is irritated; there may be pressure upon a nerve trunk in the area near the tooth; or the circumferential pressure in the bone surrounding the impacted tooth may cause the pain.

Cases of insanity, blindness, tinnitis aurium, trifacial neuralgia, otitis and affections of the eyes have been traced to impacted teeth. On the other hand, we see many cases which, even at the ages of 40, 50 or 60, have given no trouble whatever. Still this number is comparatively small, and, as the earliest disturbing manifestations are very often pathological conditions of the immediately surrounding tissues, or neuralgias, which, in their aggravated form, are difficult to correct, their early removal is indicated. Also, many severe cases of trifacial neuralgia could be traced to impacted teeth as their source of origin.

Treatment. Impacted teeth are often regarded and often referred to as being harmless. Clinical experience, however, shows that they are not uncommonly the sources of serious and varied complications. It is my opinion that impacted teeth must be looked upon as misplaced bodies, and as such they are potential sources of trouble. Experience and many reports derived from different observers confirm the conclusion that they are best removed upon the slightest provocation and often even in the absence of disturbing symptoms. When an impacted tooth is outside the possibility of usefulness, or when, in our judgment, it is likely to give trouble, it is best removed.

General Operative Principles in the Removal of Impacted Teeth.

The primary principle underlying the removal of impacted teeth in general, may be stated as follows: We have an irregularly shaped solid body—the tooth—enclosed in an unyielding covering—the bone. In order that we may be able to remove the one, we must remove a sufficient amount of the enveloping substance to create an aperture which will permit of the dislodgment of the enclosed body. This procedure must be carried out on the plan of surgical dissection, rather than by brute force, which is often exercised in the removal of these teeth. Rapidity, consistent with clean surgery, is always desirable; but speed at the expense of good surgery is not conducive to best results.

The accidents which sometimes follow the careless removal of these teeth are: fracture of the jaw; exposure of the inferior dental canal;

over-severe and often distressing trismus; fracturing of the roots and forcing these into the inferior dental canal (Fig. 217); traumatization or dislodgment of the adjacent teeth; opening into the maxillary sinus or forcing the tooth into this cavity; opening into the nasal cavity when cutting either from the palatal or the facial aspect; severing the lingual

Fig. 225. Impacted lower third molar in the ramus, near and pointing towards the sigmoid notch. Patient aged 31.

nerve; severing or injuring the nerve and blood supply of the adjacent teeth.

The history of the case illustrated in Fig. 217 is interesting. The patient was a man 26 years of age, who had an impacted third molar removed. Unfortunately, during the procedure, the end of the mesial root was broken off and forced into the inferior dental canal. There was a partial anesthesia for a few weeks, most likely caused by the trauma to the inferior dental nerve. Recovering from this, severe neuralgic pain developed. Later inflammation and suppuration ensued. Radiograph showed the root forced into the inferior dental canal. Upon the removal of this, all symptoms soon ceased.

Before describing the technique in detail, we may state that the operation should be so planned and performed that no structures, nor organs

which have a functional value, are mutilated or sacrificed. Some men advocate the removal of a good second molar tooth to facilitate the dislodgment of an impacted third molar. Others advocate the removal of the second molar, with the illusory prospect that the third molar will then be able to erupt and will occupy the position of the extracted tooth. Except in rare cases, where a tooth, through disease, is so impaired that its removal is indicated, or its relative position is such that the removal of the impacted tooth necessarily entails its mutilation, such a procedure is not to be contemplated, nor countenanced. (Figs. 218, 219, 220 and 221.) From the preceding considerations the deduction may be made that the broader principles of surgical treatment as outlined, may well be observed in the majority of cases. However, a degree of variation will become requisite to meet the needs of individual conditions. These minor details are entirely dependent upon the exact nature of the impaction, or malposition.

From this standpoint, we may classify impacted lower third molars into four general groups.

1. In the first group we may place all of those teeth which have a mesial inclination, the occlusal surface of the crown pointing anteriorly, and the roots towards the ramus. Among these, there are numerous cases of what might be considered semi-impacted teeth, their crowns being completely above the surface of the bone and only in slight contact with the teeth in front of them. These often can be removed, in a fraction of a minute, with a single turn of a well applied lever.

The mesial inclination may vary in degree and in some cases the tooth may be found lying in a completely horizontal position. There is also variation in the degree of impaction against the adjacent tooth. The area of contact may be very slight, or the entire occlusal surface of the crown may be in direct apposition with the adjacent tooth, at any point, from the crown down to the apical region. The overlying bone may also partly, or completely cover the impacted tooth and may vary in thickness. A number of these positions are shown in Fig. 222.

2. In the second group we may include all impacted third molars which are in an upright position, their occlusal surfaces facing centrally, lingually or buccally. The occlusal surface of such a tooth, as a rule, is covered by the mucoperiosteum alone, but the rest of the crown may be nearly, or completely buried in the compact bone of this locality. There is little if any impaction against the adjacent tooth and the chief difficulty in its removal is due to the compact and heavy internal and external oblique ridges in which the bulky crown is found to be lodged. Examples of teeth in this position are shown in Fig. 223.

3. In the third group we may place those impacted third molars, the crowns of which are pointed towards, or which are, in varied degrees, impacted into the ramus. They also may be located centrally, buccally or lingually. A few examples are shown in Fig. 224.

4. In the fourth group we may place those impacted third molars which are situated entirely out of relation with their true or normal location. These may be in almost any position and may be located in any part of the ramus, or the posterior part of the body of the mandible. The radiograph of a rare example of this kind (Fig. 225) I have obtained

Fig. 226. Radiograph of type of third molar, the removal of which will be illustrated in the following drawings.

through the courtesy of Dr. R. Ottolengui, who in turn received it from Dr. C. S. Kramer, the resident dentist of the Modern Woodmen Sanatorium for Tuberculosis, in Colorado.

Dr. Kramer writes as follows, in regard to this case: "There was no local nor referred pain from this tooth. It was not operated upon. The patient was unaware that he had it, but, it is our custom when teeth are missing and there is no history of extraction, to radiograph the region. The patient was 31 years of age."

Complications from Impacted Lower Third Molars.

The simplest complication arising from impacted lower third molars is inflammation of the overlying mucous membrane, caused either by the pressure and irritation of the opposing tooth from above, or

the cusps of the impacted tooth from underneath. The mucous membrane becomes highly inflamed, greatly swollen, tender to the touch, and rather painful. From the tooth region the inflammation often extends to the pharyngeal tissues and interferes with deglutition. At the early stages we may or may not have a trismus of the jaws. When the tooth is so placed that its retention is possible or indicated, the overlying gum tissue can be dissected away until the entire crown of the tooth is well exposed. The edges of the severed tissues are packed tightly away from the tooth, so that their approximation and growing in over the tooth again is prevented. Where this measure is not feasible, the tooth should be removed, the overlying mucous membrane freely incised, and the wound dressed with iodoform gauze.

Pericoronal Abscess.

A pocket often forms between the crown of the tooth and the overlying mucoperiosteum which, upon continued irritation, becomes infected through the microörganisms of the mouth. With infection, suppuration ensues and a pericoronal abscess is established. This may be acute or may pass into a subacute stage with periodical acute exacerbations, the pus escaping about the edges of the pocket. At this stage the condition is still amenable to the above described abscess treatment.

When suppuration ensues, the pus does not always remain localized and may burrow into the submaxillary triangle. This often results in severe abscess, diffuse cellulitis, involving the entire angle of the jaw and the submaxillary regions; or it may point towards the pharynx, causing a peritonsilar abscess. At times, both regions become involved. When this occurs there is a partial or complete false ankylosis of the jaws, accompanied by all the symptoms of an acute infection.

Treatment.

There are two methods usually pursued in the treatment of this last described condition: In the first a general anesthetic is administered; drainage is secured by an intra- or extra-oral incision, according to the indications of the case; the mouth is pried open by means of a gag and the tooth is removed. This should be the method of choice, and whenever conditions permit, the tooth is removed in the same operation. In the second method, drainage is secured intra- or extra-orally, and when the inflammatory symptoms have subsided or abated, the tooth is removed under general or local anesthesia. This is particularly advantageous when the impaction is of such nature that a considerable portion of bone must be removed. In the presence of active suppuration it is not advisable to open up non-infected larger areas of bone, through which absorption or dissemination of the toxic substances may take place.

The mode of treatment of these cases is largely determined by the condition of the patient, by our facilities for anesthesia and for operation, and the nature of the impaction.

In the presence of infection, especially when this is not accompanied

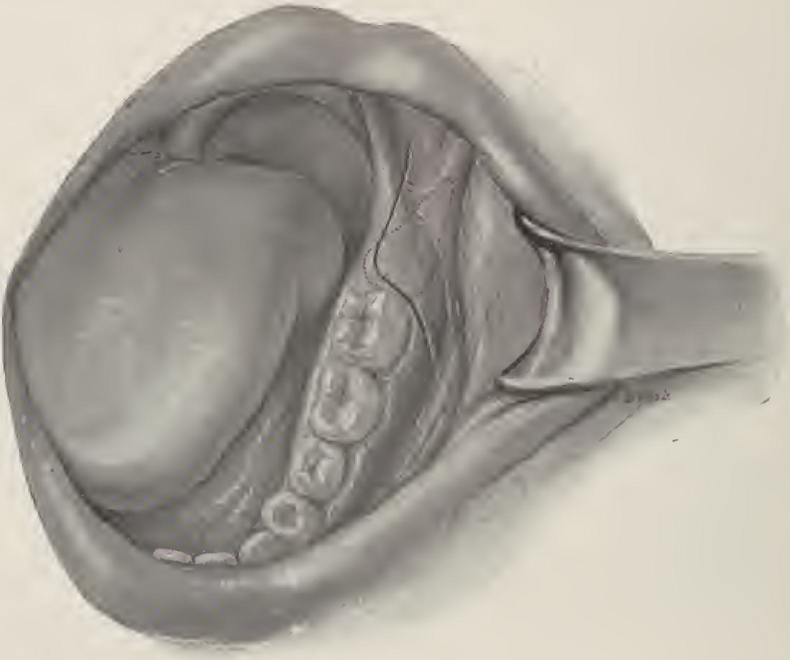


Fig. 227. The line of incision of the mucoperiosteum for the removal of an impacted lower third molar.

by pharyngeal complications, nitrous oxid and oxygen anesthesia is quite satisfactory, provided that the operation is not to be a prolonged one. When the tooth is so impacted that about fifteen minutes or more time will be required for its removal, ether should be used. When the trismus is severe and a general anesthetic is not available or feasible, extra-oral conduction anesthesia may be used to advantage. Care must be taken, however, that the injecting needle is not passed into infected tissues, or into an area where pus is present.

Technique for the Removal of Impacted Lower Third Molars.

Some lower third molars which appear to be impacted can easily be removed in a very short time. This may vary from a fraction of a minute

to a few minutes. Often these teeth are quite loose in their sockets in the presence of a severe inflammation. Truly impacted lower third molars, however, may consume from fifteen minutes to an hour, or even more time.

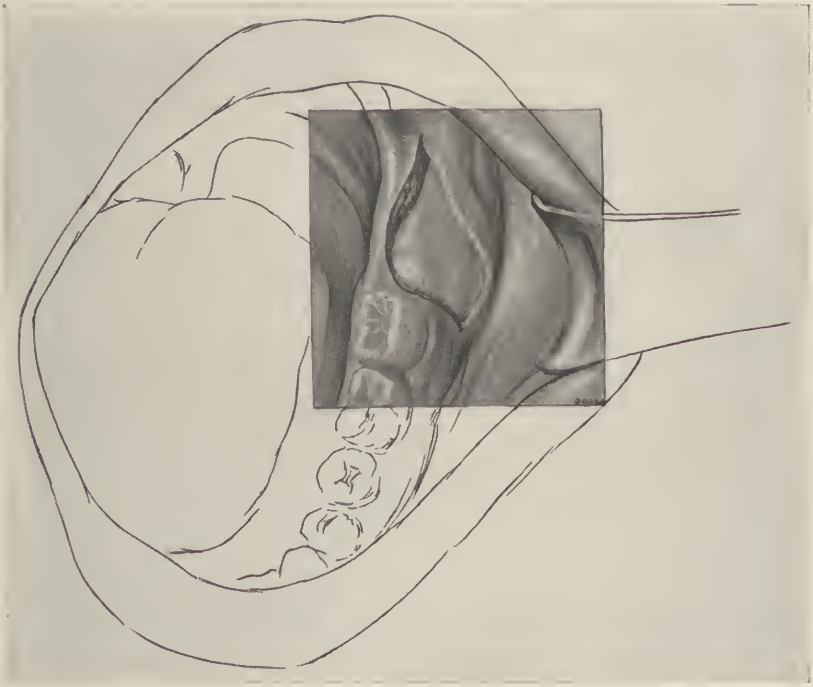


FIG. 228. The mucoperiosteum raised and reflected. The bone and portion of the crown exposed.

Prior to undertaking the removal of an impacted tooth, a thorough radiographic study of the case should be made. A radiographic examination should determine not merely the presence of the impacted tooth, but also its location, the full size of the tooth, its form, and relationship to the adjacent structures. The degree of impaction, the amount of the overlying bone and the closeness of the adjacent tooth and inferior dental canal should be particularly noted. (Fig. 226.)

The mucoperiosteum is incised; the incision commencing at the anterior border of the ascending ramus is brought forward along the median line, slightly nearer to the lingual aspect, until the alveolar ridge on the

distal aspect of the second molar is reached. Here the course of the incision is deflected towards the buccal side and brought forward well below the gingival margin of the second molar, to about the point of bifurcation of the second molar roots. This gives us practically a straight incision

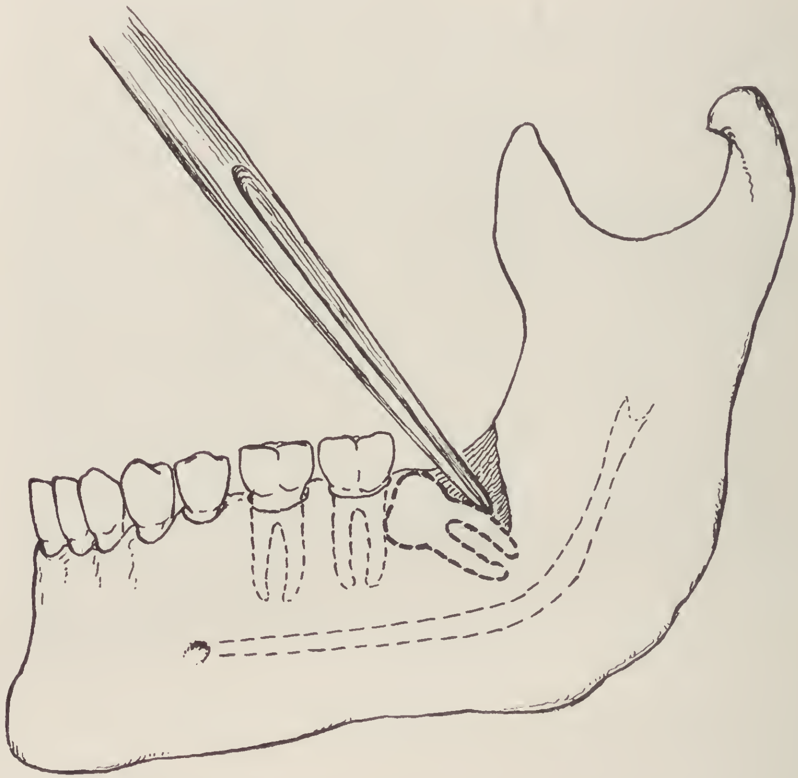


Fig. 229. Diagram showing the amount of bone removed posteriorly.

instead of a pedicled flap. (Fig. 227.) The mucous membrane is raised from the bone towards the buccal surface, and when it is retracted, the field of operation is thoroughly and clearly exposed to view. (Fig. 228.) The bone overlying the tooth in the retromolar fossa, between the internal and external oblique ridges, is, as a rule, spongy and easily removed. Greater difficulty is offered, however, by the compact external oblique ridge. With gouges and chisels or burs, a sufficient amount of the bone

is removed, to well expose the bulkiest part of the crown, and a considerable portion, about two-thirds, of the root of the tooth. When the tooth is not very deeply imbedded, it is well to cut a fairly deep groove alongside the tooth, with surgical burs, or suitable chisels. An elevator,

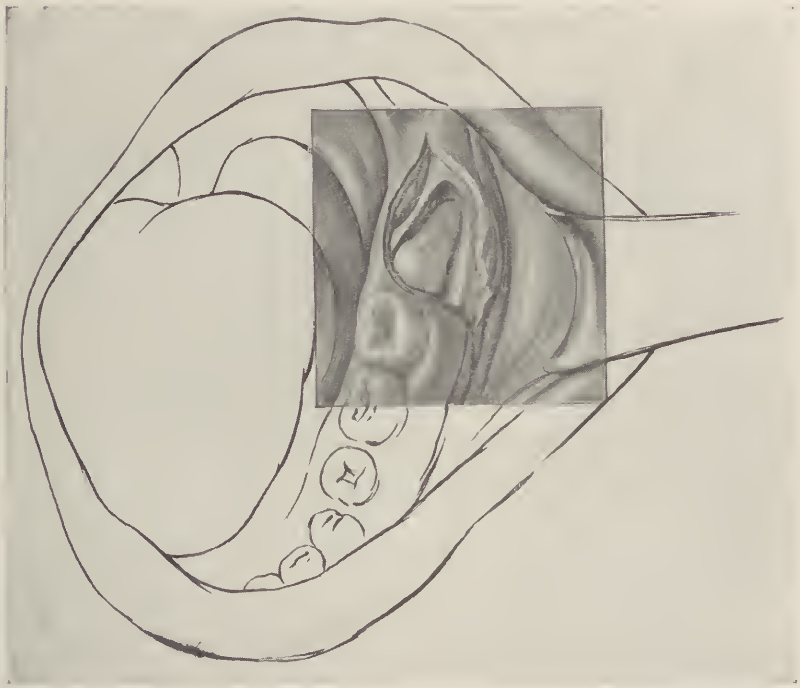


FIG. 230. The bone overlying the tooth is removed with its crown clearly relieved.

inserted into such a groove, which permits of a thorough and free leverage, will prove effective for the dislodgment of the tooth. Where the tooth is quite deeply imbedded in the compact bone, it is advisable to remove immediately, such portions of the bone as impede its removal. (Figs. 229 and 230.) The amount of osseous tissue to be removed depends upon the size, the formation and the degree of impaction of the tooth. Temporizing and vain attempts to remove it through too small an aperture, only lead to undue traumatization and unnecessary delay. It is much more desirable to remove a section of bone, large enough to permit of the ready removal of the tooth, than to incur the danger of the accidents previously enumerated. (Fig. 231.)

The tooth removed, the entire cavity is sponged out and closely inspected. Seek out all detached, or broken off fragments of bone. Note whether the bone which forms the roof of the inferior dental canal is displaced, depressed or fractured. Smooth the edges of the tooth socket

FIG. 231. The tooth is lifted from its crypt by means of elevator.

and the ragged bone surface by means of curettes; dust the entire cavity with an anesthetic powder, such as powdered procaine, orthoform, or novesthene, and dress the wound with iodoform gauze.

If the above described incision is cleanly executed, no suturing will be necessary. The elasticity of the tissues themselves, aided by the pressure of the cheek, will hold the severed tissues in the proper position.

Use of Burs. Where extensive bone cutting is necessary, a surgical bur, driven by a dental engine is of great practical value. Bone in these regions can be removed with a bur more rapidly, with less traumatization of the tissues and with less psychic trauma than with chisel and mallet. Though the use of the surgical bur is viewed with a certain amount of distrust and disdain by some operators, it is used by many, more advantageously than other bone cutting instruments. Those opposed to the

FIG. 232. Types of impacted upper third molars.

use of the bur, in this work, maintain that it is a dangerous instrument and if not thoroughly controlled, the adjacent tissues may be injured. But this is true of any instrument not properly used. They also claim that owing to the overheating of the bone, caused by the friction of the rapidly revolving bur, necrosis may follow, or, in milder instances, the postoperative pain may be more severe than where chisel and mallet are used. During these operations, however, the parts are constantly flooded with blood and saliva, whereby the bur is lubricated, so that overheating is not likely to occur. At any rate, clinical experience proves that these contentions are ill founded.

Drawing our analogies from other departments of bone surgery, we find that electrically propelled saws, trephines and drills are used for the removal, sectioning and shaping of bone. This is often done in operations of bone transplantation, in which particular care must be exercised not to undermine, nor impair the viability of the transplant. If the use of these instruments were grievously detrimental to the bone cells, this practice would be abandoned. In the choice of instruments we must be guided, however, also by experience and individual proclivities; only then can the operation be performed with celerity and simplicity.

In the great majority of cases, it is better to approach an impacted lower third molar rather from the buccal than from the lingual aspect. Lacerations of the tissues on the lingual aspect often lead to troublesome inflammation of the pillars of the fauces and false ankylosis of the jaws. In some instances, sublingual infections occur. If the wound is too deeply extended towards the floor of the mouth, either through laceration, or through the necessary surgical procedure, the lingual nerve may be severed. The buccal aspect, on the other hand, is free from actively functioning tissues, and such complications are not likely to occur, although swellings and trismus of the jaws are not uncommon, even when this procedure is followed.

Impacted Upper Third Molars.

Impacted upper third molars are rarely as troublesome as the lower ones. The symptoms here are more often of the neuralgic than of the inflammatory type. Cystic degenerations occur in a small percentage of cases. Acute inflammatory conditions and abscess formations are comparatively rare.

Their position may be an inclination of varied degrees mesially or distally, transverse, or they may point toward the palate, or posteriorly towards the tuberosity. (Fig. 232.) The chief danger in their removal is the possibility of their being forced into the maxillary sinus. Cases have been recorded where the tooth was forced into the sphenomaxillary fossa, causing serious complications and external incisions became necessary for its removal.

The removal of impacted upper third molars can be accomplished much more easily than that of any other impacted tooth. The main difficulty lies in their inaccessibility. They are usually surrounded by very frail, thin bone, which yields readily to the force necessary for the dislodgment of the tooth.

Fig. 233. A typical case of impacted upper third molar, the removal of which is illustrated in the succeeding drawings.

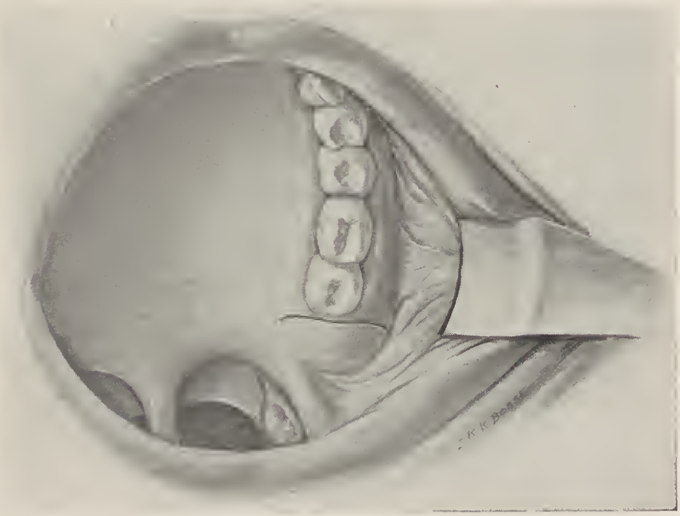


Fig. 234. Incision of the mucoperiosteum for the removal of an impacted upper third molar.

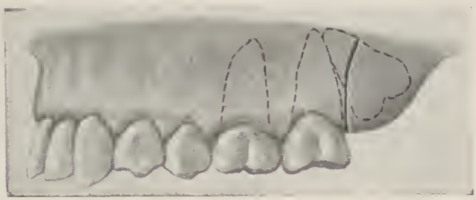


Fig. 235. Lateral view of the incision shown in Fig. 234 and diagrammatic outline of the impacted tooth.

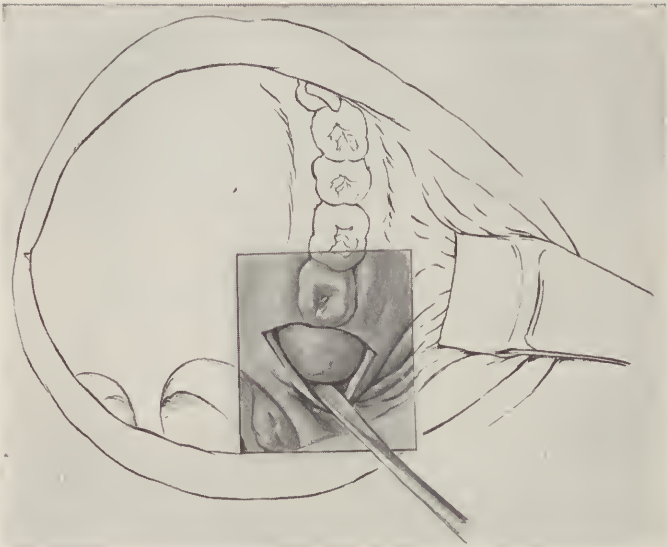


FIG. 236. Occlusal view of the mucoperiosteum pushed back over a shallow tuberosity.

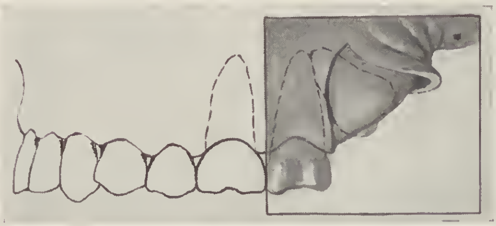


FIG. 237. Lateral view of the mucoperiosteum raised and pushed back over the tuberosity.

FIGS. 238 and 239. Triangular flaps formed by vertical incision, where the tuberosity is prominent.

Technique for Removal of Impacted Upper Third Molars.

Let us suppose that we are operating on a case such as is shown in Fig. 233. The incision of the mucoperiosteum is carried on the lingual

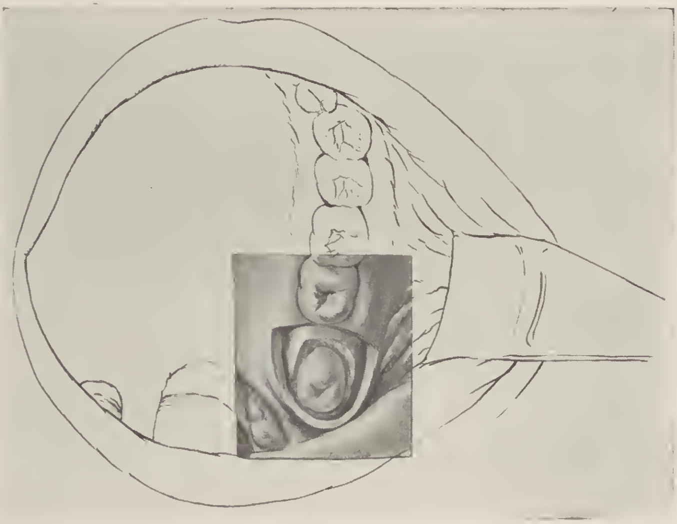


FIG. 240. Occlusal view of the tooth exposed, after the bone has been removed from about the crown.

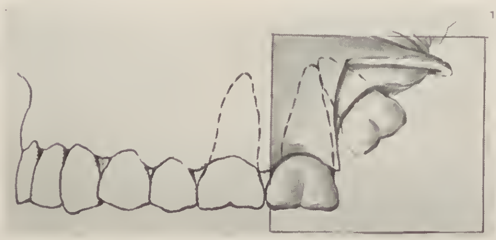


FIG. 241. Lateral view showing the crown exposed and ready for dislodgment.

aspect, from a point somewhat anterior to where the apex of the normally erupted tooth would be, across the alveolar ridge, behind the second molar, to the corresponding point on the buccal aspect. (Figs. 234 and 235.) Where the tuberosity is shallow, the mucoperiosteum can be pushed back

next and the area exposed. (Figs. 236 and 237.) If the tuberosity is prominent, a second incision over the center of the alveolar ridge, perpendicular to the first, is carried backwards, behind the tuberosity, thus making two triangular flaps. (Figs. 238 and 239.)

The mucoperiosteum having been raised, the occlusal surface of the

Fig. 242. Impacted cuspids in buccolingual relation to the adjacent teeth.

tooth is partly, or fully free from bony covering, and becomes exposed to view, in most instances. The mucoperiosteum is separated next, well over the crown of the tooth and the bone removed until the entire crown is well exposed. (Figs. 240 and 241.) We can now grasp the tooth with a pair of forceps and with a few loosening motions, lingually and buccally and somewhat posteriorly, the tooth can be dislodged.

Where the grasp upon the tooth is uncertain the direction of the force should never be upward. Often an elevator can be used for the removal of an upper third molar. By inserting its blade on the mesial aspect of the impacted tooth it is forced backward and downward. Where the radiograph shows that the roots of the tooth are irregularly formed and their apices are close to, or indenting the maxillary sinus, the tooth should be slowly loosened in its socket so that the portion of bone forming the maxillary sinus wall is not carried away. The tooth removed, all bone

spicules or fractured and detached portions of the alveolus are removed, the bone edges are smoothed and the cavity dusted with one of the anes-

FIG. 243.

FIG. 244.

FIG. 245.

FIG. 246.

FIG. 243. Impacted cuspid in buccal relation to adjacent teeth. This can best be removed from the labial aspect, as will be shown in succeeding drawings.

FIG. 244. Impacted cuspid lodged over the incisors and bicuspid teeth and approximating the median line, the nasal cavity and the maxillary sinus.

FIG. 245. Impacted cuspid, same tooth as seen in Fig. 246, but the radiograph is taken vertically through the skull.

FIG. 246. Impacted cuspid. Radiograph taken in a buccolingual plane.

thetic powders. The mucoperiosteal flaps are approximated and sutured into position and the wound is dressed with iodoform gauze.

Impacted Cuspids.

From a surgical standpoint impacted cuspids may be placed in three classes. This classification is based upon their anatomical relationship to the other teeth. First, those that are in buccolingual relationship to

FIG. 247. Impacted cuspid which should be removed from the palatal aspect as is shown in the immediately succeeding illustrations.

the adjacent teeth, the crown pointing lingually while the root points buccally (Fig. 242). Fig. 242-A shows bilateral impaction of upper cuspids in young woman 21 years of age. Note the retained temporary cuspids and the displacement of the lateral incisors. The cuspids are lodged lingually of the adjacent teeth and should be removed from the palatal aspect. Fig. 242-B shows bilateral impacted cuspid teeth in woman 45 years of age. The fixed bridge had been worn for about twelve years when the radiograph was taken. The relationship of these teeth is very much like those in Fig. 242-A. Their position rather suggests that impacted teeth, when fully formed, do not migrate, even though the environmental obstacle has been removed, unless aided by orthodontic means, which is feasible in many instances. Second, those that are placed in buccal

relationship to the adjacent teeth. (Fig. 243.) Third, those which are placed directly over the adjacent teeth. (Fig. 244.) Besides this their position may vary from a slight anteroposterior inclination, to an almost horizontal one.

FIG. 248. The line of the incision for the removal of the impacted cuspid from the palatal aspect.

Before operative measures for the removal of an impacted cuspid tooth are undertaken, it should be closely studied and its position ascertained. A radiograph taken in a buccolingual plane will show the size, the formation and the anteroposterior relationship of the tooth. (Fig. 245.) A second radiograph is taken vertically through the skull, from above downward, the rays being directed parallel, or nearly so, with the long axis of the teeth. This will show the buccolingual relationship of the tooth. (Fig. 246.)

In the examination of the mouth, we often find that a slight elevation may be present, in the outline of the tissues overlying the crown of the impacted cuspid. The lateral incisor is often malposed through the pressure of the impacted cuspid and the nature of this malposition is determined by the direction of the pressure of the impacted tooth.

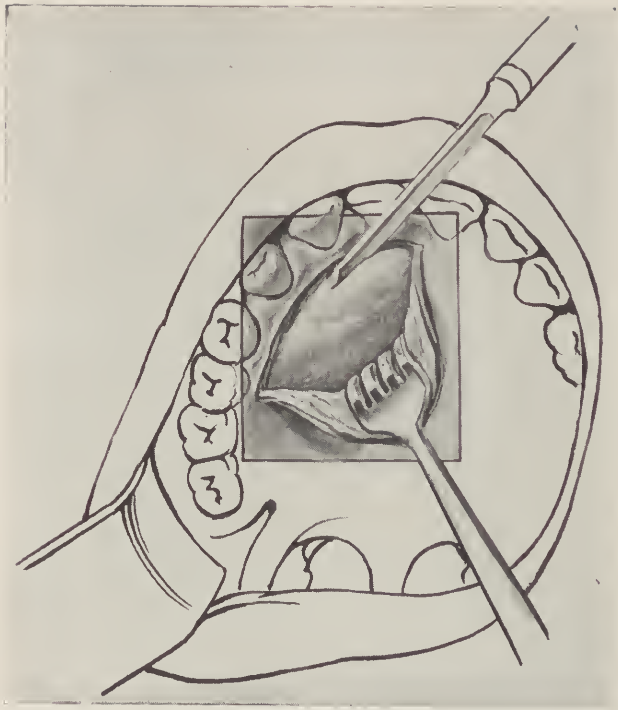


FIG. 249. The mucoperiosteum raised and the bone exposed. Note the elevation of the bone over the crown and the application of the chisel.

After a close clinical and radiographic study and orientation we are prepared to determine whether our avenue of approach is to be from the labial, or from the palatal aspect.

When the impacted cuspid is pointing towards the palate, its crown is usually lodged just behind the lateral and central incisors, close to the gingival ridge and the incisal foramen. This proximity varies in different cases. The root points in the direction of the root apices of the adjacent bicuspid teeth, that is, towards the buccal aspect and is, in most instances, deeply imbedded in the maxillary bone. The crown is covered with a very thin layer of bone, which may be perforated at points, and the thickness of the osseous tissue increases as we approach the apex. The removal of this type of impacted cuspid teeth is probably more difficult than that of any other, from a technical standpoint, when our aim is that in the operation the integrity of the adjacent teeth be not encroached upon. It should be remembered that while the impacted tooth

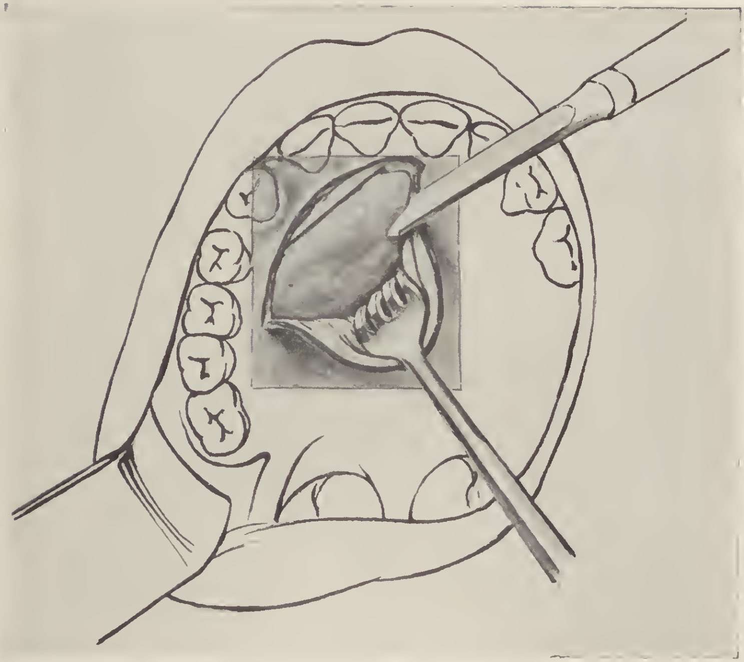


FIG. 250. The crown of the tooth exposed and the bone incised on both sides of the root alongside its broadest diameter.

is thoroughly inclosed in an individual crypt, there is but a very thin lamina of bone separating it from the neighboring teeth. The utmost care must be exercised that our surgical excursions do not pass these bony limitations.

Technique for the Removal of Impacted Cuspids.

Let us suppose that we are operating on a case, such as is shown in Fig. 247. The mucoperiosteum is incised and raised as illustrated in Figs. 248 and 249. Note that the incision is carried somewhat beyond the gingival ridge and curved back along the median line. This form of incision permits a clearer view of the crown of the tooth, which is very important; also, in this way, the subsequent suture line will be supported upon an uninvaded surface of the bone. When the flap is raised the position of the crown of the tooth is marked by an elevation or ridge of the overlying bone. With gouges or chisels, this fine layer of bone, cover-

FIG. 251. The bone overlying the tooth removed in smaller sections with the gouge.

FIG. 252. The crown of the tooth and about two-thirds of the root exposed.

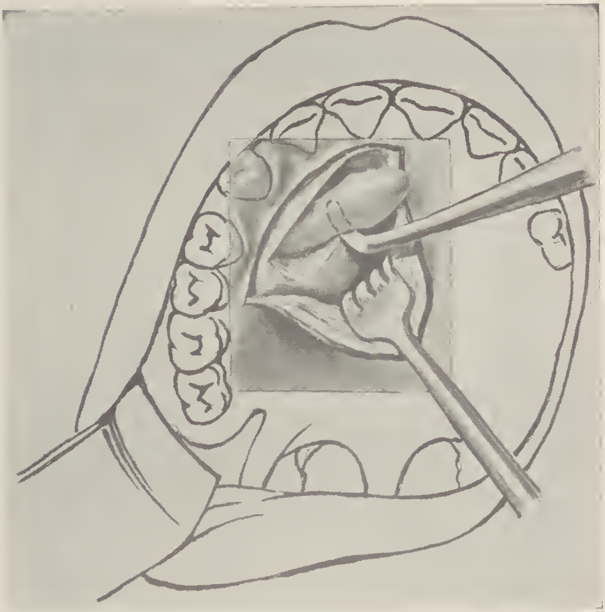


FIG. 253. The application of the elevator and the tooth being dislodged.

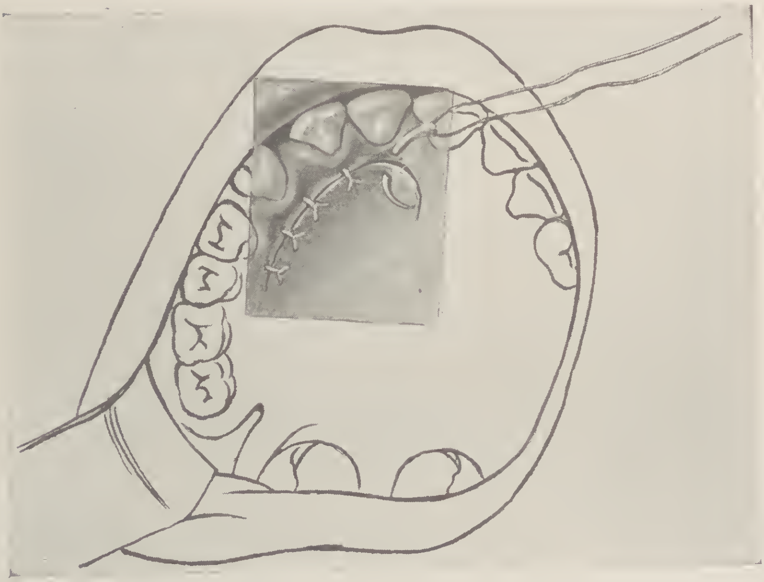


FIG. 254. The mucoperiosteum replaced and sutured into position.

Fig. 255. Incision of the mucoperiosteum for the removal of impacted cuspid from the labial aspect.

ing the crown of the tooth is removed, and the crown clearly freed from all overhanging bone tissue. It is essential that all bone which may impede the dislodgment of the crown should be removed, as this is the bulkiest portion of the tooth. (Figs. 250, 251 and 252.)

At this stage we can discern the thickness, formation, and the direction of the root. With a sharp chisel the bone is deeply grooved, close to and on both sides of the root. The root outline is closely followed until the apical third is reached. To avoid unnecessary fragmentation of the bone, the bevelled side of the chisel is held toward the tooth and the flat side toward the outer boundaries. The chisel, used for this purpose, has a slanting edge, and should be had in pairs, so that this principle, as illustrated in Fig. 250, may be carried out. The lateral groovings are so directed that the broadest diameter of the tooth root is entirely freed from overlapping bone tissue. The section of bone may then be removed in successive cross cut segments with a gouge. (Fig. 251.) On the side nearest to the median line this lateral groove is deepened and somewhat enlarged to permit of

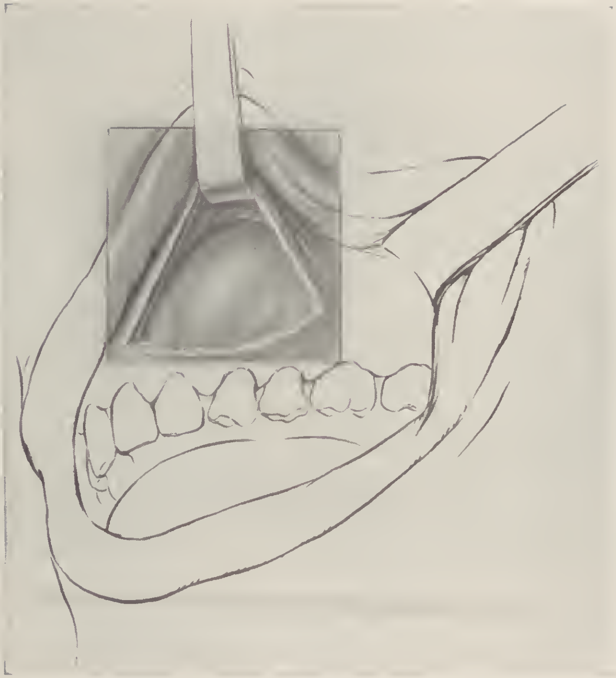


FIG. 256. The mucoperiosteum retracted and ridge of bone overlying the impacted tooth is shown.

the application of the elevator. (Fig. 253.) This is the most favorable point for the application of our leverage. Force, applied from the tooth side, is likely to fracture the alveolar process, or traumatize the adjacent teeth. When the crown can be lifted out of its bed, in this manner, and the greater portion of the root is freed from the overlapping bone, the dislodgment of the entire tooth will offer but little difficulty.

The wound is thoroughly inspected next. All detached fragments of bone, or spicules slightly adhering to the mucoperiosteum are removed; the uneven and coarse serrations of the bony edges are smoothed by means of curettes. The entire surface is sponged and dusted with an anesthetic powder; the mucoperiosteal flap is returned and sutured into position with horsehair or silk. (Fig. 254.) The needle used should conform, in shape, to the domelike curvature of the palate. The wound is loosely packed between the sutures at the most anterior point of the incision with iodoform gauze tape.

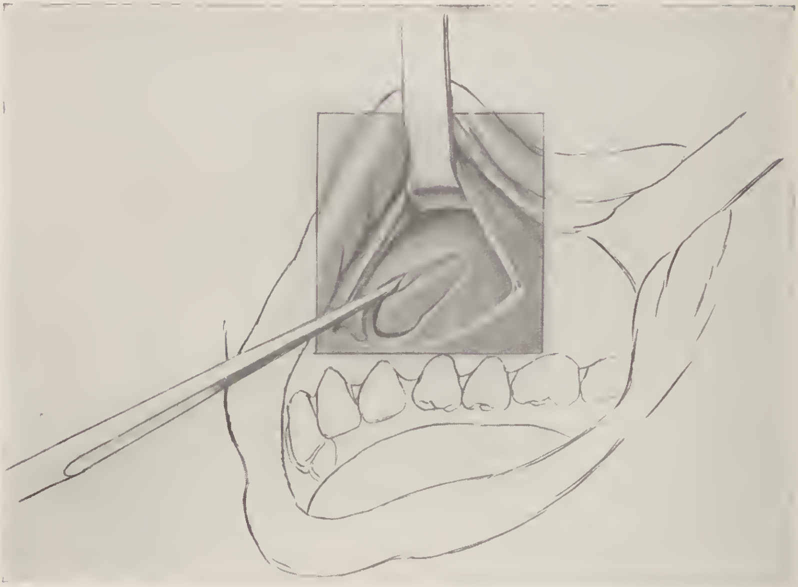


FIG. 257. Shows the application of the chisel in removing the bone.

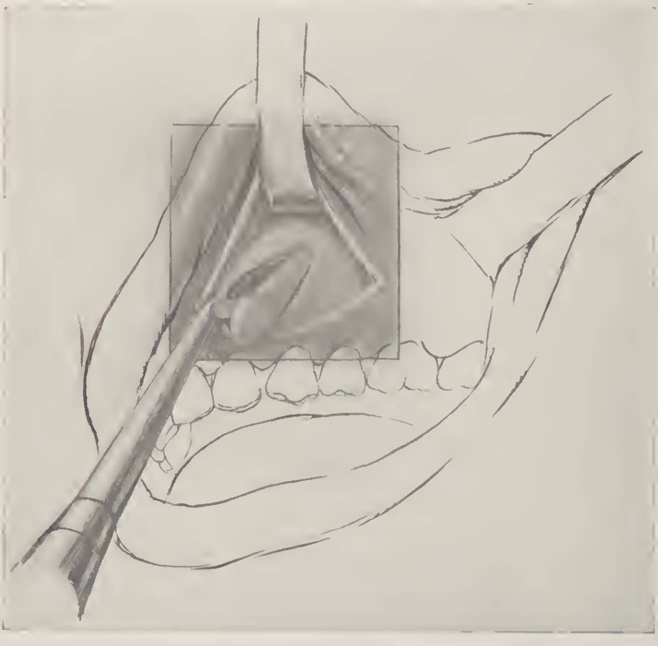


FIG. 258. Shows the application of the elevator in dislodging the tooth.

In clean cut operations no suppuration should follow. If there is no excessive secondary hemorrhage when the gauze is removed after 48 hours it need not be replaced. The line of the incision heals by primary union and the sutures may be removed four or five days after the operation.

FIG. 259. Supernumerary teeth at the median line causing separation and malposition of the incisors.

FIG. 260. Impacted upper central incisor.

The operation for the removal of an impacted cuspid situated on the labial aspect (Fig. 243) of the teeth is, in principle, very much the same as the one described, but must be modified to conform with the requirements of the existing anatomical relationships. On the labial aspect, a

semilunar incision is made, with a broad base and its convexity toward the crown of the teeth, extending from the mesial aspect of the first molar to the lateral incisor and about a quarter inch above the gingival margin of these teeth. (Fig. 255.) Semicircular flaps with narrow and thin pedicles are prone to slough because of insufficient blood supply. The bony layer

Fig. 261. Impacted central incisor and cuspid.

covering the tooth on this surface is usually thin and elevated so that the outline of almost the entire tooth can be traced. We must be careful that the maxillary sinus, which, in many instances, is indented by the root apex, is not invaded. The lateral deeper excavation for the application of the elevator should be made above, on the side furthest from the teeth. The technique is illustrated in Figs. 256, 257 and 258.

In the third class the impacted cuspid lies directly above the apices of the teeth. Our technique of operation is complicated by the necessary protection of the teeth which may be infringed upon in the operation, or if their nerve and blood supply is traumatized, or severed. It is to be understood that this infringement must never be a method of choice, yet it may be rendered unavoidable by the anatomical correlation. Where this is anticipated, it is essential that, prior to the operation, the pulps of these teeth should be extirpated, and the root canals securely sealed with fillings.

The impacted tooth in this position lies close to the apices of the teeth below, and close to the nasal cavity above. It is impossible to judge whether the nerves and blood vessels, supplying these teeth, are deflected

towards the labial, or towards the palatal side. Whatever the condition may be, it is always more desirable that the removal of tissue should be close to the teeth, rather than that the nasal cavity be entered. In some

FIG. 262. Impacted central incisor with supernumerary teeth instead of lateral incisor and cuspid.

FIG. 263. Impacted lower cuspid lying below the incisors.
FIG. 264. Impacted lower cuspid at lower border of the mandible in a male aged 31.

rare cases, it is essential that the impeding root apices be amputated in the operation. Where the teeth have been priorly treated as stated above, this procedure is to be preferred to the invasion of the nasal cavity.

These teeth, as a rule, are more readily reached from the labial than

Fig. 265. Impacted upper second bicuspids.

Fig. 266. Impacted lower bicuspids.

Fig. 267. Impacted lower bicuspid which caused neuralgia.

from the palatal aspect. They may be situated over the bicuspid teeth, or in any position closer to the median line.

Fig. 268. Supernumerary tooth below the lower bicuspids.

Other Impacted Teeth.

It would be superfluous to enter into a detailed consideration of all other impacted teeth, as, in their malposition, in their anatomical relationship, in their pathological significance and in their treatment and removal, they all present phases and features which are in all respects analogous to those already described. Details in the surgical technique for their removal will have to be modified to meet the peculiarities of the individual cases. The broader outlines of the principles presented in the above descriptions can be well adapted to all cases, and alterations in detail are entirely dependent upon the experience and resourcefulness of the operator.

Nevertheless a few instances of unusual impactions will be cited and illustrated, that the student may get a general idea of the possibilities.

We will begin at the median line, where it is not unusual to find supernumerary teeth, one or more in number. In Fig. 259 we see two cases, one a boy of twelve and the other a girl of fourteen. The general results of the intrusion are closely similar.

In Fig. 260 we see a very unusual condition, an impacted upper central incisor. One is apt to be deceived by the radiograph and might imagine

that this was but a small tooth, but on removal it was found to possess a fully developed root.

Fig. 261 shows an impacted upper right central and left cuspid in a girl 14 years of age. Note also the malposed bicuspid. Other irregularities of the arches showed definite inherent tendencies towards abnormal dentition.

Fig. 269. Impacted lower first molar.

Fig. 270. Impacted lower first and third molars.

Fig. 262.—The impacted central incisor here shown occurred in a boy 14 years of age. It may be assumed that the impaction was caused by the presence of the supernumerary teeth and this may be partly right. We note, however, that there is also, in this case, an aberration in dentition, as he never had a cuspid, nor a lateral incisor on this side. It is very likely that the supernumerary teeth developed from the dental follicles of the cuspid and the lateral incisor, both of which are missing. The lateral

incisor on the other side was also rudimentary. All of the other teeth were normal and in proper occlusion.

Fig. 263 also shows a most unusual condition, an impacted lower cuspid, the tooth lying below the incisors. Fig. 264 is even more remarkable.

Fig. 271. Impacted lower second molars.

Here we see an impacted lower cuspid, at the lower border of the mandible, in a man of thirty-one. In this individual was observed decided signs of abnormal dentition. Note the formation of the teeth in the place of the second bicuspid. Similarly abnormally formed teeth were present on the opposite side and likewise in the upper jaw.

In Fig. 265 we see two cases of impacted upper second bicuspids. In one the impacted tooth is in proper vertical position, but there is no space for its eruption. In the other the impacted tooth lies horizontally in the

bone with the crown pointing distally. Note also a retained temporary tooth. This patient was a man 23 years of age, while the other was a man aged 21.

FIG. 272. Impacted upper second and third molars, and lower third molar in same patient.

Fig. 266 shows three examples of impacted lower bicuspids lying horizontally in the bone.

Fig. 267 is somewhat similar. We see an impacted lower right first bicuspid, in a woman 28 years of age. She suffered with intense neuralgia on this side for five or six months, which terminated with the removal of the tooth. Note that the space intended for this tooth is partly bridged over by the inclination of the first molar. The tooth was lodged in the position of the mental foramen and caused a deflection of the inferior dental nerve at this point. Lack of space, or malposition of the adjacent teeth cannot account for this impaction.

Fig. 268 shows a supernumerary tooth in a woman 32 years of age. She also had a small rudimentary supernumerary tooth in the upper left third molar region. The radiographic examination was made with the object

of finding the cause for the general nervous condition and severe headaches, with which she had been suffering for the previous four years. The tooth was removed without infringing upon the two bicuspids and was followed by considerable decrease of her complaint. The patient was not seen again after three months following the operation.

That impactions of molars are not limited to the third molars is well proven in the following illustrations. In Fig. 269 we see an impacted lower first molar. In Fig. 270 there is an impacted lower first molar, and also an impacted partly developed third molar.

Fig. 271 shows two cases of impacted lower second molars, the upper being a man aged 38. And finally Fig. 272 shows an impacted upper second molar, and also an upper third molar, while in the lower jaw of the same patient there is an impacted third molar.

CHAPTER XIX.

Fractures of the Jaws.

Fracture is a solution or a break in the continuity of bone. This chapter is confined, in the main, to the consideration of those types of fractures of the jaws which we are likely to meet in civil practice. The methods in their treatment, thus set forth, can be adapted with advantage, in all types of cases, as they are based upon fundamental principles underlying the treatment of fractures throughout the body. All methods and appliances advocated are used therefore, because they are best fitted for the treatment of the parts concerned, and because inherently they are expressions of these principles.

Proportionate Occurrence of Fractures.

In civil life, amongst the bones of the face, the mandible is the third, and amongst those of the body, the tenth, most frequently fractured, according to statistics. After the nose, the mandible is the most prominent part of the face, and therefore most frequently exposed to external violence. Owing to its anatomical formation (being of a horseshoe shape), to the lodgment of the teeth therein, to the lack of that support which other facial bones obtain from the contiguous bones, it is more prone to fracture than the others. The articulation of the teeth aids greatly in withstanding the traumatic forces which may be brought to bear upon it. This is strongly suggested by the fact that the percentage of fractures in individuals who have a protruding lower jaw, or a poor complement of teeth, seems to exceed the proportionate ratio for similar accidents in more normal individuals.

Fractures of the Mandible.

Fracture of the mandible may be: Single; fracture at one point only. Multiple; fracture at two or more points.

Fracture may occur at any point between the condyle and symphysis, or at the symphysis. The point of fracture is not always determined by the thickness of the bone. I have found that the greatest percentage of fractures occur in the molar areas, where the bone is decidedly thickest and is reinforced by the heavy internal and external oblique ridges. The line of fracture, therefore, must be determined in a great measure by the direction and application of the force causing it.

FIG. 273. Illustrates a single compound fracture, through the angle of the mandible, with a vertical displacement.

FIG. 274. Fracture through the bicuspid region, with a lateral or transverse displacement. Note that while the posterior, shorter fragment is in proper occlusion with the upper teeth, the anterior fragment is badly displaced.

Fig. 275. Fracture of an edentulous mandible, with the fractured ends overlapping. Cases of this type are somewhat difficult to reduce and to maintain in the corrected position.

Fig. 276. Fracture illustrating a lateral and overriding displacement. It is impossible, at times, to bring the fractured surfaces into apposition without surgical interference. The occlusion can be restored, however, and the overlapping reduced with mechanical appliances, and union will take place in this position.

FIG. 277. Single, compound fracture in the molar region with an upward and lateral displacement. The proximal end of the shorter fragment was displaced buccally. Cases of this type offer considerable difficulty in their treatment.

FIG. 278. Single, compound fracture, through the first molar region with no displacement of the parts. These cases can be well treated by the simplest form of fixation.

FIG. 279. Single, compound, oblique fracture, with very slight displacement of the parts.

FIG. 280. Fracture through the bicuspid region. Note that while the posterior, shorter fragment is in proper position, and the teeth in occlusion, the anterior fragment is badly displaced.

FIG. 281. Fracture through the part anterior to the third molar. Note the tendency towards displacement of the shorter fragment. The third molar was loosened and therefore was inadequate to withstand the traction of the muscles.

FIG. 282. Fracture through the angle of the mandible. This was caused in an attempt to remove the impacted third molar.

The displacement of the parts may be vertical (Fig. 273), lateral (Fig. 274) or overriding (Figs. 275, 276 and 277). In some instances the bone may be fractured without displacement of the parts (Figs. 278 and 279). When the posterior or shorter fragment contains teeth which occlude with their opponents in the maxilla, this will most often be retained in its normal position (Fig. 280). Where such supporting medium

Fig. 283. Pathological fracture, which occurred in a physician 45 years of age. He had a history of syphilis and a four plus Wassermann. There was what appeared to be an epithelioma of the soft tissues in this region, a marked adenopathy, and it was difficult to determine clinically, whether the growth was a specific gumma or an epithelioma. Note the marked alteration in the bone structure and its well-defined degeneration and breaking down, which is rather suggestive of malignancy.

is lacking or inadequate this part will be displaced upward and backward by the traction of the muscles of mastication. (Fig. 281.) As a rule, the part to which the greater span of the hyoid muscles is attached will be displaced downward, and often backward and outward or inward. In fractures located in the anterior part of the mouth—in the incisor or cuspid area—displacement may be entirely absent, or it may be not so marked as in those occurring in the bicuspid or molar region. The displacement of the parts may be slight or quite marked; some of these can be readily corrected by mere finger manipulation; others, only with the exertion of considerable force.

The outer, facial tissues, covering the injured area, are rarely lacerated, but are nearly always contused, bruised and ecchymosed. When the

fracture is located between the symphysis and the angle, i.e., in the body of the mandible, or at any point where teeth are in situ, the mucoperiosteum, which is closely stretched over the bone, is usually broken, lacerated or it may be raised off the bone. The fractured ends sometimes project through the mucous membrane into the buccal cavity.

FIG. 284. Pathological fracture, caused by an osteosarcoma, in a man 48 years of age. Note the character of the bone, which is very characteristic of malignancy.

Etiology of Mandibular Fractures.

Traumatism. The most frequent causes of fracture of the mandible are external violence, such as a blow, with the first, a club, sandbag, piece of lead pipe or a baseball bat; a fall; kicks; precipitation from some height; automobile accidents; a missile projected with considerable force, such as gunshots, shrapnel or portions of shell. The injudicious removal of teeth, particularly impacted third molars or other impacted teeth, occasionally result in fracture of the mandible. (Fig. 282.)

Fractures caused by gunshots, shrapnel or shell are, as a rule, more comminuted and the shattered fragments are driven into the surrounding tissues. The soft parts, within the trail of the projectile, are badly lacerated and bruised. These conditions complicate the treatment to a great extent and retard cicatrization. In these events the wound should be

Fig. 285. Pathological fracture, caused by multiple cysts, in a sailor 28 years of age. Note that the retained coronoid process still contains two small cysts, while the missing portion of the bone was completely destroyed.

thoroughly cleansed by removing and washing away all foreign bodies and substances. Fragments of bone which are entirely separated from the periosteum, or displaced, are best removed. Portions of bone or lacerated soft tissues, the viability of which is precarious because of lack of or impaired blood supply, will only give rise to later complications and are best removed. I do not recall instances where completely

separated and displaced portions of bone, even when large, have reunited and been retained. They became necrotic and were exfoliated.

Where extensive injuries or mutilations are caused by infected shrapnel or shell, we may follow the method evolved and practiced during the late war. This consists of the thorough surgical cleansing of the wound, technically known as the "debridement," in which not merely every portion of infected necrosed or half-dead tissue or bone,

Fig. 286. Fracture through the base of the condyle, also passing through the sigmoid notch.

muscle or skin is removed, but an attempt is made to trim away all tissues which have been touched by the missile. This is done to prevent gangrene, gas gangrene or tetanus. The wound is left wide open and thorough irrigation, in most cases the Carrell-Dakin method, is instituted. Only when the infection is well under control are the tissues brought

together and the wound permitted to cicatrize. It must be obvious, however, that in the treatment of injuries about the face or jaws we must not be too lavish in the debridement and the utmost conservation of tissue should be exercised, so that all tissues which may later be utilized in the reconstruction of the parts are carefully preserved.

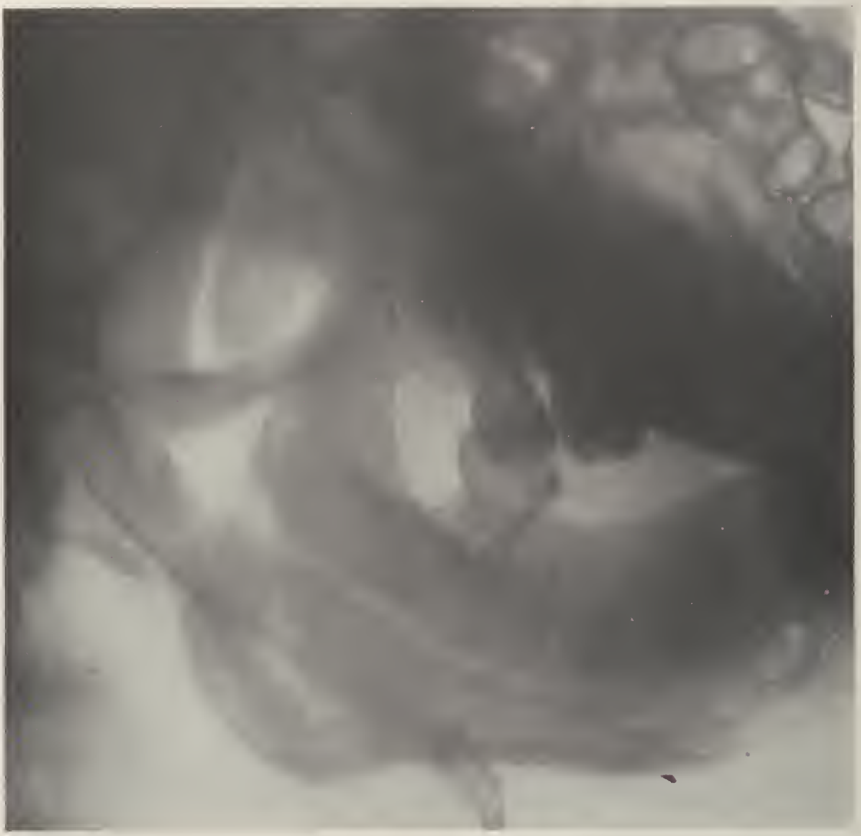


FIG. 287. Fracture through the base of the condyle in a negro 24 years of age. Note the manner of displacement of the condyloid process which is not very obvious in this picture, but it shows its displacement from the glenoid fossa. See also Fig. 288.

Pathological Fractures.

The pathological conditions, which, most frequently, cause fractures of the mandible, are osteomyelitis and necrosis. These pathological conditions may be caused directly or indirectly by infection about the teeth,

FIG. 288. The same case as Fig. 287. Shows more correctly the displacement of the condyle. The fracture had to be newly reduced and the displacement corrected.

syphilis, tuberculosis, mercurialism, arsenical, lead or phosphorus poisoning. Cryer reports cases in which the use of hydrogen peroxid, in suppurative sinuses, caused extensive necrosis by direct dissemination of the toxic substances through the structure of the bone, and fracture resulted.

Malignant growths may cause a fracture either by direct invasion and absorption of the bone, or an ensuing localized embolism may so impair the nutrition of the bone that it undergoes gradual degeneration and destruction. (Fig. 283.) Fig. 284 shows a radiograph of an osteo-sarcoma which occurred in a male patient—age 48. He experienced no discomfort from the growth and sought no attention until the mandible was destroyed to this extent. By invading the surrounding tissues, the growth attained an inoperable stage. The radiograph shows the characteristic absorption and breaking down of the bone structures.

Cysts occurring in the mandible also cause such extensive absorption, at times, that fracture of the bone results. (Fig. 285.)

Surgical Fractures. Surgical fractures are those produced by the surgeon to render more accessible a subjacent or adjacent area to be operated upon particularly in cases of malignancy. Where this procedure is contemplated, it is important that provision for the treatment of the subsequent fracture be made prior to the operation. The necessity for this provision was recognized long ago, yet it is often overlooked, even today, by some surgeons.

Classification of Fractures of the Jaws.

Fractures of the mandible permit of the same classification as those obtaining in other bones of the body. In this connection I shall confine myself to the consideration only of the type of fractures which do occur in the mandible, and a classification which is descriptive of the parts involved, and which may modify or influence the treatment of the case.

Simple Fractures. Simple fractures are those where the severed osseous tissues do not communicate with the external surfaces. Fractures located intermediately between the angle and the condyle, i.e., in the ramus, are usually, or nearly always, simple. This may be accounted for by the character and the amount of the tissues surrounding this part of the bone. The ramus is covered, on its external surface, by the masseter muscle, the parotid gland, the masseteric facia and the integument. On its inner surface, it is covered by the internal pterygoid, some fibres of the palatine and pharyngeal muscles, and the mucous membrane.

Fractures through the body of the bone are rarely simple, except when they are located in an edentulous part, of long standing.

Compound Fractures. Compound fractures are those in which the severed bone communicates with the atmosphere. Fractures occurring at the angle or between the symphysis and the angle of the jaw, i.e., the body of the bone, are almost invariably compound. The line of cleavage is often through the socket of a tooth, or through a tooth, and tends to be in the direction of the roots of the teeth in situ. The mucoperiosteum, which is closely adherent and almost stretched over the bone, is readily broken or lacerated, and through this the fracture is compounded into the buccal cavity. When the fracture is through a long standing edentulous part of the bone, the mucoperiosteum may at times remain intact.

Comminuted Fractures. Comminuted fractures are those where the bone is shattered or the broken ends of the bone are splintered, or some of its portions are broken off and separated. The alveolar process is frequently thus comminuted. Extensive splintering of the body proper occurs when the fracture is caused by gunshot, shell or shrapnel, or some other forcefully projected missile.

Complicated Fractures. Complicated fractures are those where an important structure, such as a blood-vessel, nerve trunk, muscle or tendon is severed or badly lacerated. The inferior dental artery, vein, and nerve, which structures are contained in a common sheath in the mandibular canal may be stretched, lacerated or entirely severed. It is noteworthy, that, except for hemorrhage, which is readily controlled, injury to these structures rarely gives rise to any immediate complication. In some cases there is a partial anesthesia of the part innervated by the mental nerve of the affected side, but this usually becomes corrected after three or four months. In two cases which came under my care the facial artery was severed and had to be exposed and ligated.

When the fracture is through the sigmoid notch, through the coronoid process, or through the base or neck of the condyle, the extension of the inflammation may cause a temporary, partial, or complete ankylosis. These fractures, however, are comparatively rare, and the patient does not always survive the injury. The force causing this type of fracture is usually of a crushing nature, and the injury may be accompanied by rupturing of the thin plate of bone separating the glenoid fossa from the cranial cavity. The patient dies as a result of the shock sustained, or from subsequent meningeal or cerebral complications.

Case Histories Nos. 1 and 2.

I have seen but few cases of this type two of which are cited herewith. In one case, there were some interesting atypical symptoms. The patient. male, age 35, fell in a collapsing building, from the sixth floor to the ground. Several of his ribs were broken. The line of his mandibular fracture penetrated through the sigmoid notch, the base of the neck of the condyle to the posterior border of the ramus. (Fig. 286.) An almost complete ankylosis lasted for over four months, which was gradually and ultimately entirely corrected. Partial anesthesia of both the upper and lower maxillary area prevailed for over nine months.

The second case (Fig. 287 and 288) occurred in a negro 24 years of age and was caused by a blow of the fist. When first seen, he was unable to close his mouth and moving the mandible caused considerable pain. The radiograph was taken with a lateral exposure. Fig. 287 does not show the exact displacement of the bone. Fig. 288 shows that the condyloid part was displaced towards and digging into the masseter muscle. By depressing the mandible the shorter fragment was forced into position at a second immobilization, and union, in the corrected position, followed.

Symptomatology in Fractures of the Mandible.

The pathognomonic symptoms of fractures of the mandible are: (1) Deformity: this may present as asymmetry in the facial outline, of the bone and overlying soft tissues and a drooping of the lip on the injured side. (2) Faulty articulation, or faulty alignment of the teeth. (3) Crepitation: the grating sound produced by the friction of the broken ends of the bone. As this entails considerable pain, it should not be sought. (4) False point of motion: this is decidedly the most reliable and descriptive symptom. It at once indicates the presence, the location and type of fracture. (5) Impaired function: this is evidenced by the patient's inability to bite or masticate food. (6) Tenderness and pain on point of pressure.

Other concomitant diagnostic signs are: the history of the injury, pain, excessive salivation, hemorrhage at the point of fracture, the protrusion of a tooth, or its loosening in its socket, laceration of the mucous membrane and discoloration or contusion of the surrounding and overlying tissues.

In most cases the symptoms are marked and so obvious that the diagnosis is very readily made. In others, they are slight, obscure, elusive or entirely absent. The radiograph is one of the most helpful

Figs. 289 and 290 illustrate a double fracture of the mandible, in which the removal of the impacted bicuspid, or the second molar within the line of fracture, would have greatly complicated the treatment of the case.

Fig. 290. The same case as Fig. 289.

means of diagnosis, and should be taken to determine more precisely the character of the injury.

Diagnosis. In diagnosing a fractured jaw, we must determine: (1) the number of fractures; (2) the location of the fracture; (3) the type of fracture; (4) the extent of the injury to the tissues within the line of fracture and to the adjacent tissues; (5) the nature of the deformity produced; (6) the condition, the number and distribution of the teeth present; (7) the condition of all tissues within the buccal cavity; (8) and the general health of the patient.

Given a fractured jaw case, grasp the anterior part of the mandible with two or three fingers and pull it gently forward. By so doing the broken surfaces are separated and with a gentle up and down motion, the point of fracture is disclosed.

We next proceed to place the entire buccal cavity into as hygienic a condition as circumstances permit. It is important that all active suppurative processes, and all dormant or chronic foci, or potential sources of infection, should be eradicated. Broken down or infected roots, or teeth which are of no functional value are best removed.

Occasions present, where such teeth or roots should be temporarily retained or even restored, for purposes of immobilization, or for the preservation of the correct relative position of the parts. Figs. 289 and 290 illustrate a double fracture sustained by a young man, aged 19, caused by a blow of the fist. One fracture is through the socket of an unerupted bicuspid and the second through the mesial root of the second molar. The removal of these teeth would have made the correct reduction of the fracture very difficult if not impossible; therefore they were retained until complete union had taken place. Teeth within the line of fracture, and which we know will have to be removed, are often retained to prevent cicatricial contraction of the parts (Figs. 291 and 292), or to prevent a faulty correlation of the fragments which could not be corrected otherwise. (Fig. 293.) There are others which impede the reducing of the fracture and which therefore should be removed (Fig. 294).

Treatment of Fractures of the Mandible.

Much has been written, within recent years, on treatment of fractured jaws, as a result of experiences gathered during the late war. A good part of this came from the hands of some very ingenious and brilliant men, who undoubtedly were very fortunate in the expressions of their in-

Fig. 291. There was considerable loss of osseous tissue in this case. With the removal of the teeth, a gap would have been created and further loss of bone, as well as of osteogenetic tissue. The teeth became abscessed, and were removed after cicatrization of the fracture ensued.

Fig. 292. There was considerable deformity and loss of bone in this case, and with the removal of the molar within the line fracture the condition would have been greatly complicated. The tooth was removed after union of the bone occurred.

Fig. 293. The third molar in the line of fracture, in a case such as this, should be retained until some degree of union has taken place. With its removal the posterior fragment would be displaced by the muscles attached to the bone.

Fig. 294. Fracture through the cuspid region. The cuspid tooth within the line of fracture protrudes from its socket and should be removed to facilitate the reducing of the fracture.

genuity, and therefore in the results which they have obtained. Nevertheless, one can trace throughout their activities in this work, as the dominating factor, the application of the principles which have subserved in the treatment of fractures of the jaws in the past. These principles they have most ably combined with appropriate prosthesis, to meet the needs and peculiarities of individual cases.

Having made our diagnosis and having accomplished these primary steps, we are now ready for the treatment of the fracture proper.

As suggested before, principles, which subserve the treatment of fractures of bone in general, must be observed in the treatment of fracture of the mandible, with such modifications as are compatible with the peculiarities, the functional requirements, the anatomical formation and location, and the behavior of this bone under treatment.

In the treatment proper, we recognize two important steps, i.e., First: reducing the fracture. Second: immobilization or fixation.

Reducing the Fracture.

Reducing a fracture, is the restoration of the fractured parts to their former relationship. In doing this, our best guide is the occlusion of the teeth. As the principal functions of the mandible are secured chiefly through the correct occlusion of the teeth, the restoration of this is of paramount importance, and when this is successfully accomplished, we may prognosticate a good result. Those cases where the attending surgeon overlooks the importance of, and fails to achieve, such restoration must be considered as failures. A good union at the point of fracture notwithstanding, jaws reduced in a faulty position, often need to be refractured. A correct occlusion of the teeth may be obtained without absolute coaptation of the broken surfaces of the bone, as evidenced by the radiograph. This is often inconsequential, as in many cases it does not alter, nor mar the facial outline, nor impair the function of the mandible and its component structures. (Fig. 295.) The gap so created is soon spanned by fibrous repair tissue which, even in somewhat extensive cases, may, in the course of time, undergo ossification. I have seen cases where the broken surfaces were coaptated with a great deal of care and an absolutely firm union has taken place; yet the result was a failure, because the occlusion of the teeth was not restored.

This principle must be observed, even in those cases where there is considerable loss of bone. Whether the loss of bone is due to necrosis; to extensive comminution; or when a portion of the bone is carried away by a missile, such as bullet, shrapnel or shell; or when it is removed by the surgeon in the case of a malignant growth, the remaining parts should always be restored to their former relative position

Fig. 295. Fracture through the bicuspid region with considerable fragmentation and loss of bone and a marked gap between the fractured surfaces. These can often be reduced without absolute coaptation, and the gap becomes spanned over by repair bone.

Fig. 296. Fracture of the mandible due to extensive necrosis following dental infection and osteomyelitis extending from the bicuspids to the ramus.

FIG. 297. The same case as Fig. 296, showing the adaptation of the bone after cicatrization occurred.

FIG. 298. The same case as Fig. 296, shows the occlusion of the teeth on the opposite side, despite the unossified condition at the point of fracture.

and maintained there, until some form of union has taken place. When this relative position of the parts is preserved, the defects and abnormalities can be so much more readily corrected later by means of appropriate prosthetic appliances, or by means of plastic or bone surgery.

Case History No. 3. Fig. 296 shows the radiograph of the right side of the mandible. Mr. A. G., age 45, cloak operator by trade. Patient gave a negative history, and was in good health prior to the onset of the disease. Blood examination: Wassermann, negative. He suffered from an acute abscess of a lower right molar in February, 1916. This tooth was removed before I had occasion to see the patient, and when I saw him, about four weeks after the onset of the first lesion, he had an area of necrosis, with a copious and foul smelling pus discharge through several sinuses. The necrotic area extended from the third molar to the second bicuspid, and through the entire thickness, to the lower border of the bone. The region was thoroughly irrigated and the necrosed portions of bone removed as they were being exfoliated. In the latter part of August, 1916, a large portion of bone, comprising the entire angle and part of the ramus, was removed. This created a gap about two inches long, and the left and anterior part of the mandible was displaced towards the right side. The teeth were nearly three-quarters of an inch out of alignment. The occlusion of the teeth was restored by means of wiring. A retaining appliance permitting of a limited degree of motion was worn by him for five months, after the last portion of necrosed bone was removed. The patient was discharged in January, 1917. The radiograph (Fig. 297) was taken in March, 1918, and shows that the ends of the bone had been considerably approximated through regeneration and muscular action, and the present gap is only about one-quarter of an inch. The patient has normal motion of the temporomandibular articulation, and a slightly movable false joint at the site of the injury. He enjoys a perfect occlusion of his remaining teeth, and a normal function of his mandible. (Fig. 298.)

Treatment of Comminuted Fractures. In the treatment of comminuted fractures, uniform results or response to treatment, should not be anticipated. From a clinical aspect we may classify comminuted fractures into two arbitrary groups: First; those in which the shattered fragments are retained in their normal relative position and are not detached from the periosteum. The surrounding soft tissues are only slightly injured, and the fracture may or may not be compounded into the oral cavity. If the mucoperiosteum is not badly lacerated or traumatized these tissues will unite by first intention and

FIG. 299. Comminuted fracture, in which the bone is shattered into several fragments. The fragments were not detached from the periosteum and they retained their vitality and reunited without infection.

FIG. 300. A case in which a portion of the bone and the second molar is circumscribed by the line of fracture. The bone was not detached from the periosteum and reunited without infection.

infection may not follow. In the second group, we may include those cases where the fragments of bone are entirely displaced and detached from the periosteum. The surrounding soft tissues are badly contused and lacerated, and the fracture is compounded intrabuccally or both intra- and extrabuccally. These conditions are, as a rule, attended by severe abscess formations, copious suppuration and necrosis of the shattered fragments. From time to time we meet with the suggestion that if these shattered fragments are restored to their former relationship, and so maintained through surgical fixation, they will reunite. My observation, however, in numerous cases has been that this rarely takes place in cases of the second group, even under the most favorable circumstances.

Whatever the ultimate fate of these fragments of bone may be, more gratifying results are obtained by conservative procedure. According to Duhamel, Ollier, Axhousen, and others, the osteoblastic layer of the periosteum is of special importance in osteogenesis, and, therefore we must not subject these tissues to immediate and undue trauma. It may be assumed that although such portion of bone may be ultimately exfoliated, if restored to its normal position, it may exert an osteogenetic or osteoconductive influence, analogous to that of an autogenous bone graft, as is believed by MacEwen, McWilliams, Albee and others. My clinical observation, in the treatment of extensive cases of necrosis of the jaws, where, as a result the bone is in a rather weakened condition, is, that it is best not to disturb the sequestrum until it is exfoliated. This procedure may be carried out with equally beneficial results in extensive comminutions of the mandible. The following cases are illustrative of the text of the above paragraph:

Case History No. 4.

Fig. 299 shows the radiograph, disclosing a marked comminution of the left side of the mandible. The fracture was sustained by a man, age 29, and was caused by the blow of a baseball. The fragments are retained in their correct relative position. The mucous membrane over the area was broken, but this united by primary union. The fracture united uneventfully within four weeks following the injury. There was no sign nor symptom of any abnormality or necrosis five months later, when he was last seen by me.

Case History No. 5.

Fig. 300 shows the radiograph of the lower jaw of a young woman of 26. She sustained a double fracture of the mandible in an automobile accident. On the left side, the line of fracture passes through at the mesial side of the second molar, to the lower border of the bone and up through

where the distal root of the third molar would be. The fracture was compounded into the buccal cavity. Although the tooth, which was likely an infected one, was directly in the line of fracture, contrary to my anticipation, the bone was retained because it was not dislodged and detached from the periosteum.

FIG. 301. Fracture of the lower border of the mandible. This was not compounded into the oral cavity nor upon the external surface, still the portion of bone necrosed and had to be removed.

Case History No. 6.

Fig. 301 shows the radiograph disclosing the fracture of the right side of the lower border of the mandible. This was sustained by a young man of 24, in rather robust health. He was working in a brewery and was hit by a fellow-worker with a beer bottle. A portion of the lower border of the bone was chipped out, and, although the overlying tissues were contused, the fracture was a simple one. This portion of bone was but slightly displaced, and decidedly in a most favorable condition to unite, but suppuration ensued, it necrosed and had to be removed.

Case History No. 7.

The fracture illustrated by the radiograph (Fig. 302) was sustained by a sailor (shipwright), age 31. He was hit by an implement during his work aboard ship. The fracture was badly comminuted and compounded into

the buccal cavity. The posterior fragment held only the third molar, the mesial root of which was within the line of fracture. This tooth was temporarily retained, and in reducing the fracture it was antagonized with its opponent in the maxilla, to prevent the displacement of the containing fragment. (Fig. 303.) In the hope that the large triangular portion of bone would reunite, this was forced into its nearly normal

Fig. 302. Compound comminuted fracture in which the portions of bone were detached from the periosteum. The fragments of bone were forced into close apposition and the jaw thus immobilized. (Fig. 303.) The bone fragments necrosed and had to be removed. (Fig. 304.)

relative position. Suppuration and necrosis followed, and it was later exfoliated. (Fig. 304.) After five months, there was a quite firm fibrous union. Although the patient had but a very few, badly neglected and malposed teeth, they were restored and maintained in their normal relative position. The patient was retired and pensioned because of other physical infirmities, and left the city before prosthetic restorations could be undertaken.

Case History No. 8.

Figs. 305 and 306 further illustrate that the viability of these detached, even larger fragments of bone, is rather precarious. This fracture was caused in a fist fight, and was sustained by a young man, age 24. The

Fig. 303. The same case as Fig. 302.

Fig. 304. The same case as Fig. 302.

FIG. 305. Compound, comminuted fracture, through the bicuspid region. Both the upper fragments containing four anterior teeth, and the lower triangular part, were detached from the periosteum and were exfoliated.

FIG. 306. The same case as Fig. 305.

FIG. 307. The same case as Fig. 306, showing the external wound.

fracture was compounded into the oral cavity and upon the chin. (Fig. 307.) In the radiograph (Fig. 306) we can see two large fragments of bone. The alveolar or upper portion contains four anterior teeth, all of

Fig. 308. Fracture, in which immobilization was attempted by drilling holes into the bone and securing the parts with silver wire. Note the extensive necrosis which followed, and the fragment of bone within the wire loop.

which had to be removed *en masse.* The large triangular segment constituting a portion of the body and the lower border was likewise exfoliated. The lateral parts of the mandible were restored to and maintained in their proper relative positions until union had taken place. This prevented their sagging together and thus creating an abnormality which would be difficult to correct. The defect was later corrected and the teeth

supplied with a prosthetic appliance, and the patient enjoys a normally functioning mandible.

Fixation in Fractured Mandibles. Experience has proven that fractures of the mandible are not amenable to surgical methods of fixation such as are often successfully employed, particularly in the long bones. The use of Lane plates, metal screws or nailing together the fragments with bronze nails as practiced by the late Murphy, of Chicago, or securing them with silver wire or kangaroo gut, result almost invariably in extensive necrosis so that the sequel of the treatment is much more serious than the initial injury was.

Even in other departments of bone surgery, these methods are rapidly being supplanted by autoplastic bone transplantations. Metallic foreign bodies introduced into living tissues always cause a degree of irritation which may result in absorption, degeneration, and necrosis. This establishes a point of lesser resistance which further predisposes the parts to infection.

Fig. 308 shows a radiograph illustrating such a case. The fracture was sustained by a young man, age 26, through the left bicuspid region. The mandible was exposed by an external incision. Holes were drilled through the substance of the bone on both sides of the line of fracture and the parts fastened with a silver wire. Observe the isolated, necrosed portion of the bone within the wire loop. Unfortunately for this patient, the necrosis extended posteriorly, and, ultimately, the entire left half of the mandible was lost.

The best, and uniformly good results, are obtained by the judicious construction and application of mechanical appliances which are particularly designed for the correction of the deformity existing, and to maintain the disrupted parts in their normal relationship.

The requirements of a method or appliance to be employed are: (1) efficiency; (2) expedience; (3) adaptability to fit the needs of the particular case; and (4) convenience in construction and application. The construction of some appliances requires a deal of ingenuity and skill.

Some operators fall into the error that they advocate and adhere to the use of a single favored appliance in the treatment of all cases and conditions. We may state positively that a certain type of appliance is best indicated for groups of fractures of a certain class, or those presenting certain characteristics. But much more favorable results can be obtained if every case is individualized, and studied from all angles, as suggested above. These are important enough to bear reiteration: (1) The number of fractures; (2) the location of the fracture or fractures; (3) the type of fracture; (4) the extent of the injury of the

Fig. 309. Double fracture, caused by a blow. One fracture is through the left cuspid and the second through the right second molar region. Note the deformity. The displacement of the parts was of such nature, that anterior and lateral traction had to be applied, and the anterior teeth had to be wired.

Fig. 310. Radiograph of the same case as Fig. 309.

FIG. 311. The same case as Fig. 309 reduced and immobilized. Note the absolute restoration of the occlusion of the teeth.

tissues involved; (5) the displacement of the parts; (6) the nature of the deformity produced; (7) the condition, number and distribution of the teeth present; (8) the condition of the entire buccal cavity; (9) and the general health of the patient. From such a study of the case, we can more rationally determine what forces must be applied and how these forces are to be exerted to attain the desired result. In deciding upon an appliance for a particular case, we must be guided by these considerations.

Whenever a method, or appliance, meets with the above stated requirements, we have attained all that is desired. It is rarely essential that an appliance should be excessively complicated, or superfluously elaborate. Unless some elaborate feature of an appliance offers advantages towards greater efficiency in the treatment of a case, such construction is not to be advocated, since its utility is but temporary. In a healthy individual, the average fracture unites within four to six weeks. The formation of abscesses, age, systemic complications such as syphilis, tuberculosis, anemia, diabetes, poor general health, will in a measure antagonize cicatrization and due allowance must be made for such existing conditions.

Dr. Gilmer's Method of Fixation.

The method first advocated by Dr. Gilmer, of Chicago, that of securing the mandible by wiring the teeth to their antagonists in the maxilla and so restoring their former occlusion, may be used to the best advantage in the majority of cases. The Angle brass ligature wire, as manufactured by the S. S. White Dental Manufacturing Co., serves this purpose most admirably. It is more tenacious than silver or iron wire. It does not oxidize and is not acted upon by the fluids of the mouth. A double strand, of the medium or heavy wire, is passed through the interdental spaces and fastened about the neck of the tooth, just beneath the free margin of the gum. All wires should be twisted in one direction to prevent their unwinding later. Wherever conditions permit, it is best to select opposing teeth, or else to plan the wiring so that when the jaws are brought together the traction upon the wires will tend to correct the deformity caused by the displacement of the parts. The bicuspids and first molars are best suited for this purpose. These teeth are accessible, more or less bell-shaped and are more strongly rooted than the anterior teeth, and consequently better able to withstand the stress which will be brought to bear upon them.

The anterior teeth, particularly the lower ones, are not quite so favorable. In some cases, however, the displacement of the parts is of such nature that only anteroposterior traction will bring about the

Fig. 312. Double fracture of the mandible, one through the second molar and the second through the bicuspid region. Note the deformity created.

FIG. 313. The same case as Fig. 312, with the fracture reduced and immobilized. Note the absolute restoration of the occlusion of the teeth.

desired result. When the anterior teeth must be utilized for immobilization, two of the lower ones should be included within one wire loop, and this is to be secured to one of the upper teeth. (Figs. 309, 310 and 311.) Because of their conical shape, wire loops cannot be retained or only with difficulty, upon the cuspid teeth. Where compelled to use such a tooth, an Angle band or one made of German silver with a lug on its labial aspect, may be cemented on the tooth.

It is advisable to wire as many teeth as we conveniently can. The considerable tension or traction produced by the attempt or act of deglutition, sneezing, yawning, coughing or speaking, is thereby distributed. The wiring of teeth within the line of fracture must be avoided wherever possible. Those who have judiciously tried this method will agree with me that it offers several decided and distinct advantages over other methods of fixation. It is efficient, expedient and convenient.

A unique advantage of wiring is that we can always see the relationship of the parts. Should there be a displacement, due to sagging or breaking of the wires, this can readily be detected and corrected. I know of no method whereby the occlusion of the teeth can be restored with equal precision. (Figs. 312 and 313.) For these reasons, and because of the uniformly good results obtained, I employ wiring as a method of preference.

That the interposition of an appliance between the teeth tends to disturb the absolute correlation, must be quite obvious. Even when a well-constructed splint is used, there is always a possibility that, owing to either uncorrected angulation of the bone at the point of fracture, or an adaptive modification of the temporomandibular articulation, malocclusion may result. Even these deformities can often be corrected, in their early stages, by means of wiring. The tension exerted by the wires causes a gradual yielding of the newly formed callus, which as yet has not undergone complete ossification, and in a similar way, may correct the deformity produced at the temporomandibular articulation.

One of the objections raised against wiring is that the gums about the wired teeth may be unduly injured, or that the teeth may be dislodged from their sockets by the traction upon them. If carefully done, the placing of the wires entails no greater and probably less injury to the soft tissues than the cementing of a splint or the adjustment of Angle bands would. Nor have I observed the dislodgment of teeth when a sufficient number of teeth were properly wired, even under very unfavorable conditions. Another objection raised is, that the patient is unable to open his mouth and masticate his food. This, however, must

FIG. 314. The single arch, or cap splint

be looked upon as a necessary part of the treatment, just as in other fractures surgical rest is secured by absolute immobilization by means of plaster casts, extension contrivances and confinement of the patient to bed from four to five weeks or longer. I prefer subjecting the patient to a temporary inconvenience rather than to obtain a result which leaves him in a crippled condition for life.

Splints.

All forms of splints must be so constructed that they permit the application of the principles which accord with the rational treatment of fractured jaws as set forth above. Those to be described in the following pages permit of a wide range of modification and this renders them adaptable for most cases. They may be made of precious or base metal, and may be cast or swedged. They serve to equal and frequently to better advantage if made of vulcanized hard rubber. When made of this material, they can be more readily constructed, adapted and placed, or removed with greater facility.

Single Arch Splint.

The single arch, or cap splint, is about the most satisfactory means for immobilization. (Fig. 314.) The advantage which this appliance offers is that it

secures a complete fixation of the fractured bone, without immobilization of the temporomandibular articulation. This makes mastication and all other functions possible during treatment. The utility of this splint is limited, however, to certain types of cases only. It is best indicated for conditions where the deformity is not very marked and in which the displacement of the parts can readily be corrected by mere finger manipulation. The fracture must be essentially so located that there are two or three well-rooted teeth on either side of it. The splint is cemented onto these teeth and the fragments are thus held in their intended relative position. When a fracture is so located that were it not for the marked displacement and the force required in its reduction, a cap splint could be used, the fracture may be reduced by means of wiring first, and ten days or two weeks later, when the fragments tend to stay in their corrected position, the wires may be replaced with a splint. When the fracture is at the angle, behind the third molar, between the second and third molars, or at some point where the teeth do not offer adequate anchorage for the retention of the containing fragment, this splint is contra-indicated.

Technique for Making Splints.

The method of construction of a cap splint is as follows: An impression is taken, preferably in modeling compound, of both the upper and lower jaws. From these, plaster casts are made, which will be accurate models of the existing conditions of the jaws, reproducing also the deformity of the fractured mandible. The disarrangement of the parts is corrected by dividing the plaster model of the mandible at the point of fracture and these segments are articulated with the cast of the maxilla. The plaster segments are assembled in this corrected position and united with a fresh layer of plaster. A heavy sheet of tinfoil is burnished over the lower teeth, covering them to the gum margin. The tinfoil is covered with a single layer of red or pink base plate wax. The occlusal surface of the wax splint is conformed to the indentations of the cusps of the upper teeth. The pattern so formed is reproduced in black or red vulcanized rubber with the tin lining in position. The tin lining prevents the vulcanite from entering undercuts and the interdental spaces and when removed provides a space for the cement and facilitates the setting of the splint.

Before cementing the splint in position, it is well to permit the patient to wear it loose for one or two days. By so doing, we give an opportunity for the adaptation of the displaced parts to the splint, and we also determine points of irritation of the gums that may be caused by it. Such points of chafing can be readily corrected by removing the encroaching rubber.

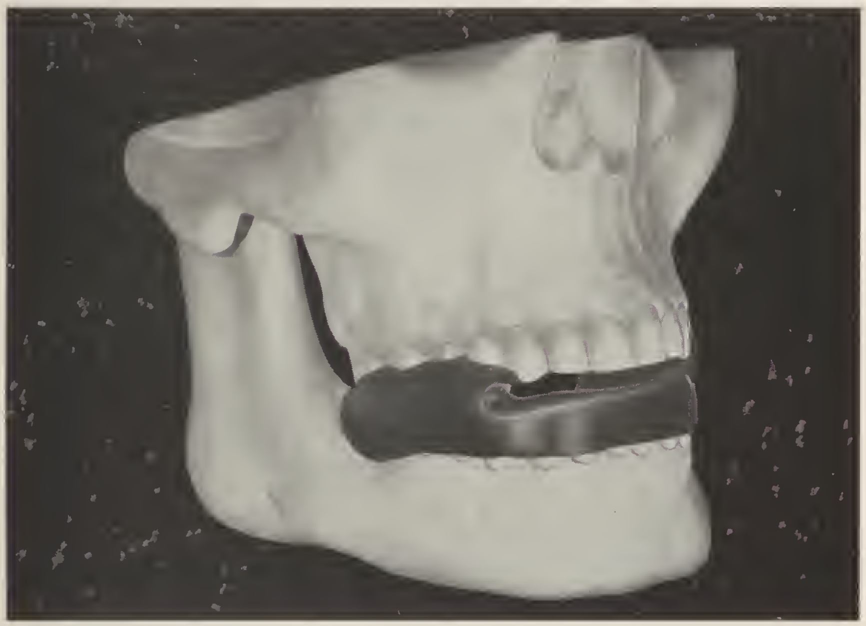


FIG. 315. The double arch, or Gunning splint.

Technique for Cementing Splint.

In cementing the splint, we pack off the salivary secretions first, by means of gauze—sponges or cotton rolls. The tooth surfaces are dried with absorbent cotton or bibulous paper. The black oxyphosphate of copper is the best cement as it is hygroscopic and adheres more tenaciously to the teeth. The cement is mixed to a creamy consistency and introduced into the splint, covering the entire inner surface. The splint is placed over the teeth and the fractured parts are forced home into the splint. This must be held firmly as when the yielding of the fingers permits a displacement of the parts, union will take place in this shifted position. It sometimes occurs, that, owing to such shifting, upon the removal even of a well-constructed splint, the parts will have united in a faulty alignment. This is one of the disadvantages of the cap splint, that, when it is once set, we are unable to observe or ascertain the relationship of the parts. It has been suggested by some, that perforations be made into the occlusal surfaces of the splint through which we might see when the teeth have reached their intended position. This is good practice in some cases, and particularly where thin swedged metal splints are used.

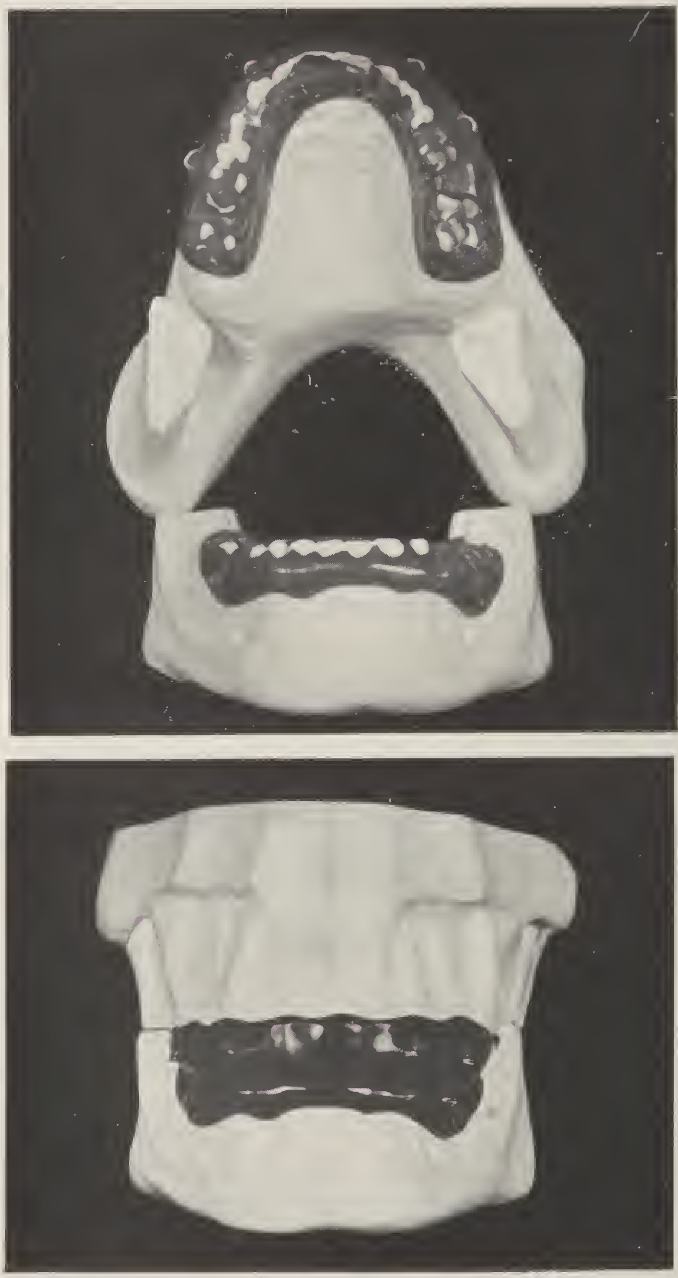


FIG. 316. Splint constructed for the treatment of fracture of both jaws. Each jaw is reduced individually and immobilized through the wire loops.

FIG. 317. Appliance provided with a jack-screw to correct an acquired deformity, following loss of bone.

The "Gunning" Splint.

The intermaxillary, or interdental "Gunning" splint (Fig. 315) in some cases is very helpful, and in some instances is the only appliance which can be utilized to good advantage. Modified forms of this appliance are used by some men, almost exclusively, in the treatment in all types of cases and conditions. In my hands its practical use is confined to such cases only where the condition, position, or lack of teeth, or the location of the fracture does not permit of more reliable fixation. With this splint absolute fixation cannot be secured. It must be used in conjunction with bandages and we depend chiefly upon these for immobilization. For example, in a case of an edentulous mouth, an edentulous upper or lower jaw, or where the teeth present are so distributed that they cannot be approximated. Where plates are worn by the patient, the splint is constructed to be applied over the dentures. It is particularly useful in young children during the period of dentition, when the permanent teeth have as yet not erupted. In all such cases the splint

acts partly as a guide in the restoration of the correlation of the parts and as a means of fixation. After the fractured parts have been assembled and maintained in the splint for a few days, there is usually no difficulty in retaining them there.

This splint is constructed much in the same manner as the single arch splint, but the upper surface is molded against the model of the upper jaw, so that an occluding surface is made for the reception of the maxillary teeth.

The splint illustrated in Fig. 316 may be utilized in cases where both the upper and lower maxillæ are fractured. These fractures, as a rule, are accompanied by extensive comminutions. It is best to reduce the fracture of each maxilla and the mandible independently and complete immobilization may be secured by wiring through the loops imbedded into the vulcanite. The double arch metal splint advocated by Dr. Cryer can be used to distinct advantage in a great many cases of this type.

Fig. 317 illustrates a type of appliance which I have used in several cases with very satisfactory results, where the fragments were permitted to sag together and to partly close a gap created through an extensive loss of osseous tissue. The appliance is provided with a jack-screw. By the gradual extension of this the parts were restored to their normal position.

Abscesses in Fractured Jaw Cases.

The complication which often attends fractures of the mandible is the formation of abscesses. It is my impression that this occurs in sixty to sixty-five per cent of cases.

The most prolific causes of abscess formations are: First; as most fractures are compounded into the oral cavity, we may have a direct infection of the wound by the organisms of the buccal cavity. Second; fragments of necrosed bone, or foreign bodies, will exert irritation which often leads to suppuration. Third; fragments of teeth, or traumatised teeth within, or in the proximity of the line of fracture. As fragments of bone, or traumatised teeth containing gangrenous pulps are the most prolific causes of abscess formations here, their presence should be determined by means of the radiograph, and whenever conditions permit, they should be removed prior to reducing the fracture. When suppuration ensues, the abscess should be treated independently of the fracture proper, by securing thorough drainage intrabuccally. Quite frequently, however, external incision must be resorted to. Suppuration will continue until all irritating factors are removed, or exfoliated. Often, small spiculæ of bone, which are not disclosed by the radiograph, become en-

tangled in the meshes of the soft tissues and prolong suppuration. These can be detected best by gently probing the abscess tract, and when found are removed.

Fig. 318. Complete ossification of fracture reduced in false position. Note the fine osseous formation. The case had to be refractured to restore function.

Feeding in Fractured Jaw Cases. During the period of immobilization, the patient must subsist on liquid and semi-solid food. This can be taken through a tube or sipped through the interdental spaces, or passed through a space where some of the teeth have been removed. The removal of good teeth, for this purpose, is not to be tolerated. The diet must be of high nutritional value, so that the patient's health is not undermined. Milk, soft boiled eggs, broth, chowder, beef-extract, chopped meat and other similar food substances will keep the patient in comfort and maintain his weight to a large degree. With the proper regulation of the diet, the bowels should be kept open and the patient advised not to do any unduly strenuous manual work.

The oral cavity must be frequently and thoroughly irrigated with mild antiseptic and deodorant solutions. A solution of potassium permanganate, or boric acid, will serve well in most cases. The use of

FIG. 319. A case in which a double fracture was not reduced, and the parts united in false position, with resulting facial deformity.

FIG. 320. The same case as Fig. 319. Showing the unsatisfactory correction of the lip. This represents the best effort at closing the mouth.

hydrogen peroxid is to be discouraged and in my estimation has no place in bone lesions within the buccal cavity. When the teeth are wired, or when the splint is cemented in position, the patient should be instructed to brush all accessible surfaces with a tooth-brush and dentifrice. When a removable appliance is used, this should be immersed in permanganate solution, or in a dilute solution of hydrogen peroxid and thoroughly scoured and brushed with soap and water every twenty-four hours. If strict hygiene is not observed, the appliance and the breath become fetid and very offensive.

Refracturing. When a fractured mandible is reduced in a faulty position, the deformity produced and the consequent impaired functions are so irksome, that the patient prefers to go through a corrective operation rather than to endure these through life. Such deformities result in alteration of the facial outline and expression, the impairment of speech, vocalization, and the primal function of mastication. It would be hard to estimate just how far-reaching the ill effects of this deformation may be upon the mental processes of the patient. Among psychopathologists there is a decided and increasing appreciation of the subtle relationship existing between mind and body, and the detrimental influences that may be exercised by acquired or congenital physical defects.

In the recent stages, prior to the complete ossification of the callus, this operation is a comparatively simple one. Under anesthesia, the mucoperiosteum is raised from over the point of fracture, the fibrous primary callus severed and the fragments separated. The case is treated as a recent fracture of a similar character.

When ossification is complete, the operation is more difficult and complicated. Whenever conditions and the position of the fracture permit, the operation should be performed intrabuccally. The mucoperiosteum is raised off the bone on its entire circumference and by means of a Gigli saw or surgical burs, the bone is separated at the point of fracture. This can sometimes be accomplished with chisel and mallet. It is best to divide the bone at this point, as it is here where the angulation causing the deformity exists. The complexity of reducing these fractures is greatly augmented by the need of correcting the adaptive modification which invariably obtains in the temporomandibular joint after it has functioned in the false position for some length of time.

Fig. 318 shows the fracture united in a false position. Note marked bone formation and the interlacing of bone trabeculæ at the line of fracture. This case was refractured with a good result.

Figs. 319 and 320 present a case in which a very poor, or no

attempt, was made to reduce a double fracture, and the parts united in this false position. This patient sustained a double fracture of the mandible, one being through the right molar and the other through the left bicuspid region. Note the abrupt V-shaped position of the jaws.

Fig. 321. Fracture through the angle of the mandible, the ramus being retained in a practically normal position by the juxtaposition of the broken surfaces.

After this union had occurred, an attempt was made to correct the deformity by resecting a part of the ramus at the base of the condyle, through an external incision. Naturally, this also failed, as the angulation causing the deformity was in the molar and bicuspid region. Note also the poor correction of the lip, Fig. 320, this being a photograph with the lips and mouth closed.

Fractures through the angle of the mandible, through the third molar socket, or sometimes even more anteriorly when lodged behind the last tooth on the injured side, offer special problems in their treatment, and therefore must be specially considered. The ramus in these cases may be retained in its proper position by the juxtaposition of the broken surfaces. (Fig. 321.) In a considerable number of cases it is displaced by the muscles of mastication. The displacement may be upward and forward, or tilted inward or outward. The displacement may be so marked that the anterior surface of the ramus presses against the upper

teeth, and this becomes a constant source of irritation, ulceration, and discomfort, or may even interfere with function. The displacement is nearly always determined, or caused, by the lack of teeth in this posterior fragment to counterbalance the traction of the muscles, or because of loss of a portion of bone.

FIG. 322. Shows fracture with considerable loss of bone in a young man age 20. The ramus is drawn forward by the muscles because of loss of support.

In the early stages, these displacements are amenable to finger manipulation, and the problem lodges rather in maintaining this posterior fragment in its reduced position. This can be accomplished, very frequently, with the double arch splint, as well as with the cap splint. The splint is extended to cover the anterior part of the ramus without causing too much pressure. It is not always a simple matter to determine beforehand, just how deeply this should be extended. I prefer to have this posterior extension to fit the ramus as far from the bone as the occlusion of the teeth permits. When the pressure is inadequate, this can always be modified by placing a portion of modeling compound over the surface next to the bone. This method can also be used where a gradual depressing force is desired.

In the later stages, if a part of the fractured surfaces have remained in apposition despite the displacement, satisfactory osseous union may

occur. There may or may not be a flattening of the facial outline to a varying degree, but function is good. In some cases I have found that such a case was complicated merely by the pressure against the upper jaw. The anterior part of the ramus was exposed intrabuccally, and a moiety of the bone was removed.

If the displaced position is permitted to persist for some time, immediate reduction becomes impossible. The ramus practically becomes fixed, through a modification of the masseter, pterygoid, and temporal muscles, or there may be a callus or fibrous union. An attempt at gradually correcting the displacement in these cases is more apt to bring satisfactory results. For this purpose, it is best to utilize the upper jaw as the *point d'appui*. An appliance in the form of a splint may be constructed which is fixed to the upper teeth. A small saddle is constructed of metal or vulcanized rubber to fit over the anterior surface of the displaced ramus. This is attached to the upper appliance with a solid metallic bar, in such a manner that it can be extended by operating a jack screw. This is gradually extended without causing too much pressure, and the slowly acting force may also stimulate a corrective change in the tissues acted upon. If too aggressive, or too sudden pressure is used, the process becomes unbearably painful and the soft tissues ulcerate.

Where there is a considerable loss of bone, as a rule, two things may happen. The ramus is drawn forward, or forward and upward, and although there is no bony union, the bone surfaces are quite closely approximated and held in place by a firm fibrous union. The balance of the mandible is maintained in its normal position, the teeth contained therein articulate, and function is good. Such a case is illustrated in Fig. 322. This occurred in a young man 21 years of age and was caused by a gunshot. The radiograph was taken about eight months after the injury was sustained. His chief complaint was the facial asymmetry. Note to what extent the ramus was drawn forward to meet the anterior fragment and the new bone being laid down at the ends of both stumps.

There are other cases which are not quite so fortunate. The ramus is tilted forward and upward, and outward or inward. The gap may be considerably larger. The balance of the mandible is drawn over to the injured side; there is a marked facial deformity; the teeth are out of occlusion and function is impossible. In these cases it is good practice to maintain the disrupted parts by means of wiring, or splints in their proper relative position, until all surface wounds have healed and infections, or infecting factors, have been eliminated. When this occurs, autogenous bone grafting may be resorted to.

Fractures of the Maxillæ.

Fractures of the maxillæ are comparatively rare and for all purposes they may be classified in the same manner as those of the mandible.

In some cases, both the upper and lower jaws are fractured simultaneously in the same individual.

The etiology is always a forceful traumatic injury, caused by some

FIG. 323. Fracture of the maxillary bone caused in the removal of a bicuspid tooth. The line of fracture communicated with the maxillary sinus. No appliance was necessary in this case. The fragment of bone was forced into position and held there by the overlying mucosa. Union followed in about fourteen days without complications.

external violence such as a fall, a kick, a blow with an implement, automobile and railroad accidents, gunshots, and even by extracting a tooth. (Fig. 325.)

Fractures of the upper jaw may be unilateral or bilateral and the different types may be arbitrarily grouped into four general classes. (1) In the first group we may place all of those which involve a portion of the alveolar process only; (2) those which penetrate beyond the alveolar process and involve a part of the maxillary bone proper, often complicating the maxillary sinus; (3) those in which there is fracture of some of the facial bones. The most frequently fractured are the malar, the nasal, the palate bones and the zygoma; (4) those in which some of the cranial bones are likewise disrupted or fractured.

All fractures of the maxillæ are caused by some external violence of

considerable force and the majority are therefore compound and comminuted. This circumstance often complicates their treatment. Other complications which may be present are: invasion (Fig. 323) and infection of the maxillary sinus; invasion of the nasal cavity; injury to the teeth and their investing tissues; injury to the infraorbital nerve; injury to the lachrymal gland; severe hemorrhage which is not always easy to control. When the point of hemorrhage cannot be discovered, or stopped by tamponing the bleeding surface or by compression, or the severed vessel cannot be reached it may become essential to ligate the internal maxillary, or the external carotid artery.

Because of the violence causing these fractures, severe shock is not uncommon, particularly in those cases which are complicated with fracture of the cranial bones. There is generally, also, considerable contusion and laceration of the facial tissues.

Diagnosis of Maxillary Fracture.

Diagnosis can be made with comparative ease in all those cases in which only the alveolar process, or the maxillary bones are involved. There are conditions, however, in which the diagnosis is obscured by swelling, contusion and lacerations of the face and the tissues of the oral cavity. The radiograph is helpful in all cases, but not always clear cut, because of the overlapping of the cranial bones.

A free diagnostic manipulation of the parts is at times contraindicated because of traumatic shock or other complications. It is important, however, that an accurate diagnosis be made just as soon as possible and it is essential that provision should be made for the early treatment of the fracture. Prompt measures in these cases are even more important than in the treatment of fractures of the mandible. It has been my experience, that where delay was inevitable because of the complications present, the disrupted parts which were easily moved and replaced at first, even after five or six days could not be restored completely, or only with the exertion of considerable force. The broken surfaces may also become altered to such an extent that their absolute coaptation becomes impossible.

Case History No. 9.

This was well illustrated in the treatment of a man, 38 years of age, who sustained a double fracture of the mandible and fracture of the right maxilla, in a railroad accident. He was taken to a near-by hospital and was brought on to New York about fourteen days later, when he was placed in my care. Upon examination I found that the fractures of the mandible could be freely moved and manipulated but the fracture of the maxilla seemed to have completely solidified, and it was impossible to move or displace the parts with forceful hand or finger manipulation.

He also had a fracture through the left infra-orbital ridge, the outer wall of his left maxilla was caved in and there was fracture of a nasal bone. Although the contusion and lacerations of the soft tissues were not completely healed, except for the deformity of the facial bones there was no sign of fracture, or mobility. The fractures of the mandible and that of the maxilla were reduced independently and immobilized. It was impossible, however, to completely correct the maxillary deformity.

Case History No. 10.

The tendency towards rapid healing of injuries in the maxillæ was also observed in the case of a child five years of age. He fell into an elevator shaft and his head was pinned between the elevator and the wall. Besides other injuries, he sustained a fracture of the left maxilla. The fracture penetrated through the socket of the lateral incisor, through the median line of the palate and diagonally through the region of the maxillary sinus, well into the malar bone. Upon examination, I found that the hard palate was completely separated at the median line; the overlying soft tissues were severed and the fractured part of the maxilla was displaced outward and upward. The part was freely movable and could be forced into position with very little finger pressure. Because of the grave traumatic shock all interference was contraindicated and treatment had to be deferred for ten days. At this time the patient was put under ether and I found it impossible to restore the disrupted parts with finger manipulation or even with considerable force exerted with the palms of the hands. Fearing that the shock might be too severe, separation of these partly united parts with a wedging force was not deemed advisable. A wire arch, such as is used in orthodontia, was securely ligated to his teeth. Other, fairly heavy brass wires were attached to these and passed across the palate to the opposite side. By twisting these, pressure was exerted on both sides of the maxilla, with a tendency to approximate the disrupted parts. The wires crossing the palate were tightened each day and the direct pressure thus exerted was also aided by the pressure of the tongue. In less than ten days the disrupted parts were restored to their former position and the teeth were in normal occlusion, except the lateral incisor, which had to be removed. The gradual pressure acted more favorably and more effectively than forceful surgical measures would have.

In the treatment of fractures of the maxillæ, the same primary measures must be carried out which are essential in the treatment of all infected wounds and fractures regardless of the part of the body involved. (1) Arrest hemorrhage; (2) remove foreign bodies; (3) remove fractured or fragments of teeth, also all completely detached and infected portions of bone; (4) antisepticise the wound with a mild germicidal

solution; (5) restore the soft as well as the osseous tissues into the most favorable position for repair; (6) immobilize and secure surgical rest.

Infection of the Maxillary Fracture. If infection and suppuration supervene the cause of this is not always easily detected. In this it is advisable to investigate and radiograph all of the teeth in the injured region. The radiographic examination should include more than the structures investing or immediately surrounding the teeth. In some cases portions of teeth or fragments of bone are driven to considerable depth within the line of fracture.

If the fracture traverses the maxillary sinus, this cavity may, or may not become infected. Where the outer wall of the sinus is caved in to such an extent that it seriously encroaches upon this cavity and causes considerable facial deformity, this should be corrected. In the absence of external laceration it is more advisable to approach the bone lesion from the oral cavity than to expose it through an external incision. Where external incisions are made, the scar becomes attached to the bone so that it is often more disfiguring than the original deformity was. In the absence of a complicating factor the sinus should be treated the same as the other infected parts. In most cases where there has been no prior disease in the maxillary sinus, this will clear up with the cicatrization of the other injuries.

Whatever the nature of the fracture may be, when immediate complete treatment is not permissible because of complications as above stated, it is advisable to restore the parts as closely as possible to their intended position and to maintain them there with temporary silk, or wire figure of eight ligatures applied about the teeth. This can be accomplished with very little disturbance. The occlusion of the teeth and the pressure of the mandible, reinforced with a Barton bandage, aid considerably in this temporary fixation. The disrupted parts in the maxillæ are not so prone to be displaced as they do not move in function and are not acted upon by the traction of the muscles as is the case in the mandible.

Simple Fractures. The simplest types of fractures are those in which a portion of the alveolar process with the teeth contained therein is broken off. This is not an uncommon accident in the removal of teeth. The fracture may include one or more teeth. Sometimes the tuberosity is broken off in the removal of an impacted third molar, or deeply imbedded roots. The broken off fragment remains attached to the mucoperiosteum alone. Repair of these broken off fragments occurs much more readily in the maxillæ than in the mandible. When there are a sufficient number of firm teeth on both sides of the fragment, this can often be securely immobilized with a simple orthodontic

appliance, or with a stout wire bent to the shape of the arch. When the fracture includes the last tooth posteriorly, a single arch splint is the most effective appliance for the case. If the use of a splint is decided upon, it is good practice to adapt this to all of the teeth, covering them to the gingival margin. The occlusal plane of the splint should be made in conformity with the occlusal surfaces of the opposing teeth. In these simpler cases, the palate does not have to be covered. The splint should be cemented into place or the pressure of the lower teeth supplemented with a bandage may give sufficient retention.

When the tuberosity becomes fractured, in a considerable number of cases, the maxillary sinus is exposed, or clearly opened. In this event it is best to restore the bone fragment into its proper position and hold it in place by suturing the mucosa with a few silk or catgut ligatures. The disrupted parts should be compressed as closely as possible, because the approximation, or the apposition of the tissues, aid cicatrization considerably and thereby the possibilities of infection are reduced. The restoration of the normal outline at this point is unimportant.

Complicated Fractures.

In fractures of the second group the outer wall of the maxillary bone is fractured to a variable degree and the palate may be split at the median line, or at some other point. The degree and the direction of the displacement is dependent entirely upon the nature and direction of the force causing the fracture. The displacement may be upward and outward, or downward and towards the median line. In still other cases, the entire lower part of the maxillary bone is broken from all its osseous attachments, the line of cleavage being well above the teeth, parallel with the palatal process, carrying this and the floor of the maxillary sinus with it. If the separation upon the palate is not too large, and the fracture can be readily reduced, a cap splint fitted over the teeth of the complete arch, secures a very satisfactory fixation. If the palatal gap is considerable, and there are not sufficient teeth on the opposite side to offer adequate anchorage, the splint should be constructed as an ordinary dental plate, covering the entire palate. Whenever the anchorage offered by the teeth and the alveolar ridges seems insufficient, the retention of the splint may be aided by the pressure of the mandible and bandages.

Bilateral Fractures.

I have seen but a few cases in which the fracture was bilateral. In one case, both maxillæ were torn from their bony attachments and there was a complete separation of the palate at the median line. In all bilateral fractures, a complete double arch splint can be used to the best advantage. In their construction, the two arches are coördinated with the original occlusion of the teeth. The

disrupted parts are assembled into this appliance and held securely by the pressure of the mandible, aided with a stiff bandage. Where the coöperation of the patient cannot be depended upon, a plaster bandage may be used. This is applied as the Barton bandage, but the bandage roll is saturated, before it is put on, with a very thin watery mixture of plaster of Paris. When the plaster sets, the bandage is completely unyielding. Care should be exercised that the bandage be so placed that it does not extend much beyond the point of the chin, posteriorly. When it is placed too deeply, it causes considerable chafing of the tissues and may also interfere with deglutition.

Appliances for Treating Fractures.

It may be well here to mention the several ingenious appliances invented for the treatment of fractures of the mandible and the maxillæ, which depend upon external anchorage for immobilization. Many of these were conceived and constructed, before our present better understanding of and better facilities for oral prosthesis. Of these we may mention the Kingsley splint and the appliances devised by Martin, Beltramy, and others. They are used in combination with external bandages and straps, attached to metal or leather chin and skull caps, and are dependent upon the chin and skull for the *point d'appui.* Most of these are obsolete, as they are complicated, cumbersome and not efficient.

In the very few cases in which I have attempted to utilize the principle upon which they are based, I have found that the immobilization was inadequate and that the absolute coördination of the upper and lower teeth, which is so important in the treatment of fractures of the jaws was entirely uncertain. I have therefore abandoned their use completely. Still, there may occur some few very exceptional cases in which some of them may be used with advantage.

The prognosis of fractures of the maxillæ is nearly always favorable. Where no complications set in, the fractured parts unite more rapidly than do fractures of the mandible. Even smaller fragments of bone reunite with greater frequency than in the mandible. When a deformity of the maxillary arch results, this can be corrected with prosthesis, much more easily than similar deformities occurring in the mandible.

Bandages.

Bandages are made of muslin, gauze, linen, or some other fibrous material. The fabric is rolled up and cut in widths and lengths, in accordance with the needs of the parts to which they are to be applied.

Bandages are used to hold in apposition, broken or severed tissues, to

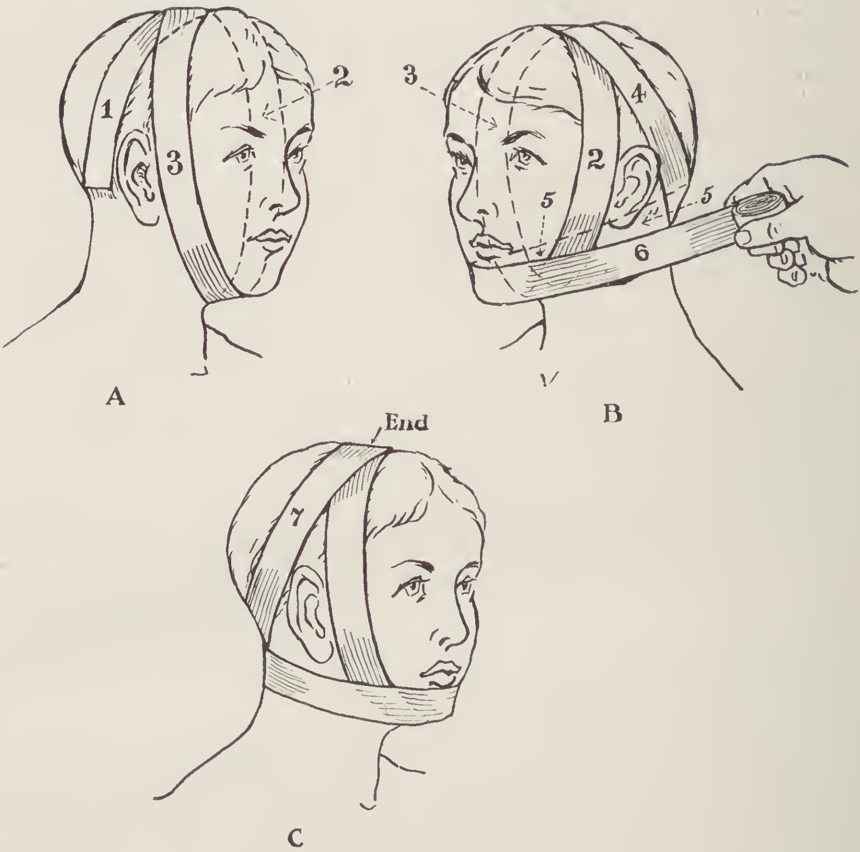


FIG. 324. Barton's Bandage.

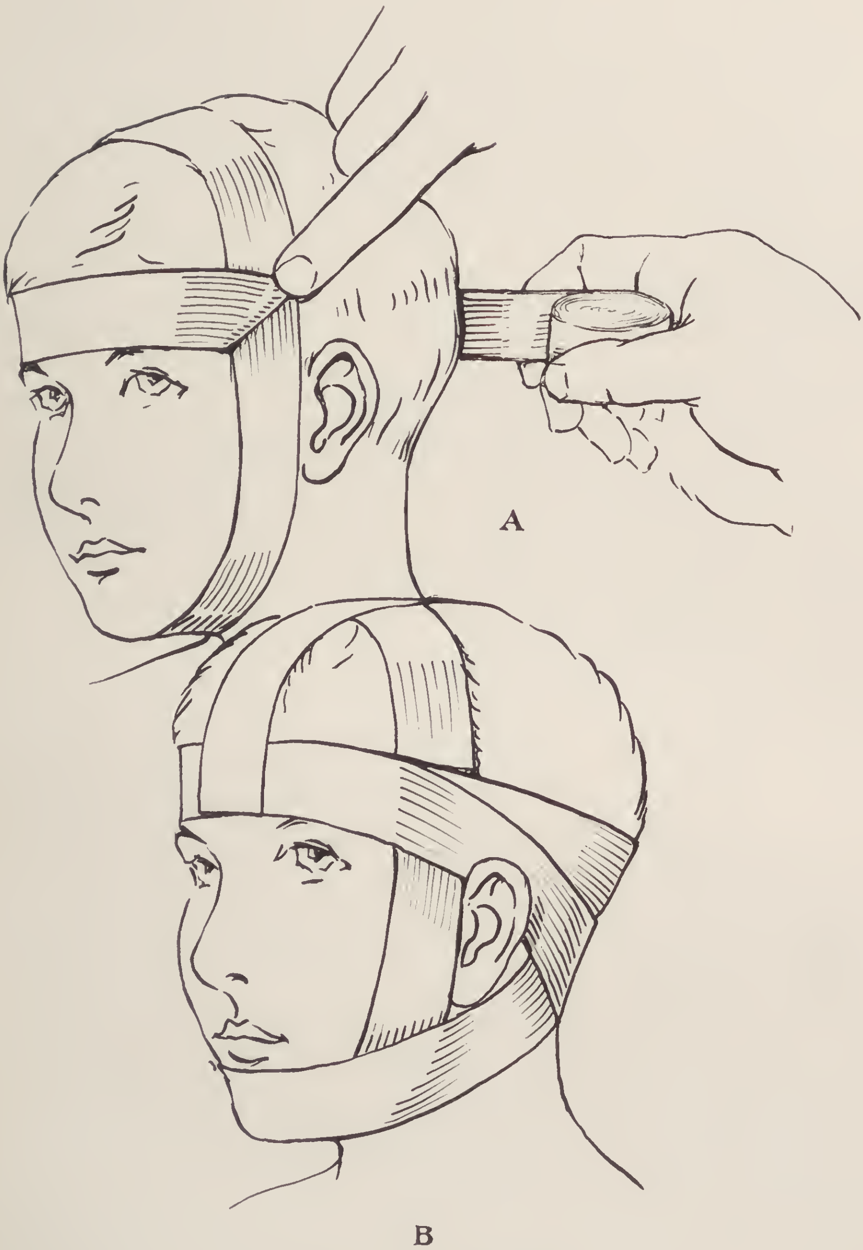


Fig. 325. Gibson's Bandage.

Fig. 326. The four-tailed bandage.

protect body surfaces, to produce pressure, and to hold a dressing or medicament in position.

They are frequently used in surgery and in the treatment of injuries about the head, face and jaws. They can be used with advantage in the treatment of fractures of the mandible and the maxillæ as a temporary, or supplementory means of immobilization. With a well applied bandage, considerable pain and discomfort may be prevented in the early treatment of a fractured jaw. In these injuries, prior to fixation of the parts, every movement, walking, talking, deglutition, causes a degree of motion of the broken parts and the friction of the broken surfaces causes, in some cases, excruciating pain, especially when the inferior dental nerve has been injured, severed or exposed.

Bandages can be used as the sole means of fixation in the treatment of the very simplest types of fractures, when there is no displacement, nor tendency towards displacement of the disrupted parts, or when these are held in their normal relative position by the juxtaposition of the broken surfaces. They are indispensable in the treatment of all those cases where the appliance used cannot be relied upon for absolute fixation.

Application of Bandages.

The bandages which are best suited for the treatment of fractures of the jaws are, the Barton, the Gibson and the four-tail bandage. All of these are very simple to apply after a little practice. In the application of all roller bandages, the outer surface of the bandage should be placed next to the skin so that, as the bandage is being applied, it rolls away from the body. If the inner surface is applied to the skin, there is a tendency to pull the bandage out of the hands of the bandager.

Barton's Bandage.

I have found the Barton bandage (Fig. 324-A, B and C) to be very satisfactory in the treatment of fractures and other injuries about the face and jaws. A two-inch, ten-yard bandage is used. The bandager stands on the right side of the patient; the roll of bandage is held in the right hand and the free end is grasped with the left. The initial end is placed just behind the right ear over the mastoid process (Fig. 324-A); from here the bandage is carried across the vertex of the skull, down the left side of the face just in front of the ear, underneath the chin, up on the right side of the face, across the first layer of bandage upon the vertex, and over the left mastoid process; next, the bandage is carried underneath the occipital protuberance, over the nape of the neck, across the chin and back to the starting point (Fig. 324-B). These turns are repeated five or six times to give stability to the bandage. Pins are inserted to secure all crossings, or adhesive tape may be used for the purpose (Fig. 324-C).

Gibson's Bandage.

For the Gibson bandage (Fig. 325-A and B) a two-inch, ten-yard bandage is used. The bandager stands on the right side of the patient and the roller bandage is held in the right hand with the free end grasped with the left. The outer surface of the initial end is placed upon the vertex, and from here the bandage is carried down the left side of the face, underneath the chin, up on the right side of the face just in front of the ear, making three turns in this manner. The fourth turn is carried to the temporal region and here the bandage is inverted (Fig. 325-A), making three turns around the forehead and the occiput; at the fourth turn, the bandage is carried over the occiput to the nape of the neck and three turns are made across the chin; at the fourth turn the bandage is reversed again and carried over the vertex to the forehead (Fig. 325-B). The bandage is pinned at all crossings.

The Four-Tail Bandage.

The four-tail bandage (Fig. 326) is the simplest of the head bandages and like the Barton's bandage it is used to support the mandible and to exert pressure upward and backward. A fairly heavy strip of muslin or linen one yard long and three inches wide is used. The two ends of the muslin are split in the middle to about three or four inches from the center. A slit is made in the center part which is placed over the point of the chin. The lower two tails are carried over the sides of the face and firmly tied over the vertex; the upper two tails are tied over the nape of the neck; the free ends are tied next to the corresponding ones upon the vertex.

CHAPTER XX.

Dislocation and Luxation of the Temporomandibular Articulation.

Dislocation is the partial or complete separation or displacement of two articular surfaces. This may be: (1) traumatic; (2) congenital; (3) pathological.

Traumatic dislocations of the mandible are not uncommon. They may be partial, or complete; unilateral, or bilateral; simple, where there is no external wound; compound, where there is a surface wound communicating with the injured joint; complicated, where some of the structures, such as muscles, ligaments, or blood vessels are severed, or the bone is fractured.

Dislocation of the mandible consists of the dislodgment of the condyloid processes from the glenoid fossa of the temporal bone. The displacement may be forward, or upward and backward.

When speaking of dislocations of the mandible, we usually mean the bilateral, forward, complete, simple dislocation. This is the one which we commonly meet: the others do not occur in the mandible, or are very rare. (Fig. 327.)

The etiology of these dislocations are: forceful or excessive opening of the mouth, as in the act of yawning, laughing, vomiting, or the attempt to open the mouth beyond its normal capacity; dental operations, such as the taking of impressions; the insertion of a mouth gag under anesthesia, or the removal of lower teeth. A blow or external violence rarely causes dislocation, except a blow upon the chin while the mouth is open.

The symptoms of bilateral dislocation are as follows: the mouth is ajar and fixed, the masseter muscle giving the impression of tension; the condyles slide from the glenoid fossa over the eminentia articularis where it becomes fixed by the muscles and ligaments; the patient is unable to close the mouth, although a slight opening movement may be possible; speech and deglutition are difficult; the saliva is dribbling from the mouth; there is a marked depression in front of the external ear and an elevation over the displaced condyle; there may be pain of varying degree, or the condition may be entirely painless.

Fig. 327. Dislocation of the mandible in a woman 32 years of age. Note the outline of the ramus of the mandible, suggesting that the coronoid process is butting against posterior surface of the maxilla. This dislocation was of two days' standing.

When the dislocation is once reduced, in most cases there is no further trouble. From the complete absence of disturbing symptoms following reduction, we may conclude that the dislocation is not essentially attended with rupture of the capsular ligament, or injury to the articular disk, and that, in the painful cases, such injuries are likely to exist. There may be a tendency towards recurrence, and some individuals, after they have had the mandible dislocated once, must guard against forceful opening of the mouth. I have seen a young woman, twenty-one years of age, who could dislocate and replace her mandible with voluntary muscle manipulation. Sometimes the action of the muscles had to be assisted with pressure of the palm of the hand.

Treatment of Dislocation of the Mandible.

In the early stages, reducing a dislocated mandible offers very little difficulty. In doing this, I have found that a comprehensive manipulation is more effective than sheer force. The operator may assume two different positions: (1) The operator stands in front of the patient who is so seated that the head is not above the operator's waist line. The thumbs are rested upon the molar region on both sides and the ramus depressed, while the chin is elevated from underneath with the other fingers. In this way the depressing thumbs act as the fulcrum for the leverage, the condyles are raised to the summit, or over the eminentia articularis, and with a slight backward thrust they glide back into position. (2) Where more force is necessary than can be exerted in this manner, the operator may stand behind and overhanging the patient, so that the pressure of the thumbs is aided by the bearing down of the weight of the body, while the other fingers elevate the anterior part of the mandible. In most literature the suggestion is made that the thumbs should be protected against biting by winding towels about them. I have never found this necessary, as the bone glides rather than snaps into place.

The mandible is not infrequently dislocated during the administration of nitrous oxid. This is done either by excessive manipulation of the mouth gag, or by the force used in the removal of lower teeth. Whenever this is suspected or noticed, the dislocation should be immediately reduced, while the patient is still under the influence of the anesthetic, as it is much more easily done then than after the patient has recovered.

In these immediately reduced cases, there is scarcely any trauma, post-operative pain or discomfort, in which event no treatment is necessary. When the patient experiences pain, rest should be secured by means of a Barton bandage and the patient is instructed to refrain from chewing hard

food for at least ten days or two weeks. Function should be resumed guardedly and gradually.

Old dislocations, even after one or two weeks, are not quite so easily reduced, as the muscles and ligaments become fixed and rigid. In this event the patient should be put under a general anesthetic, preferably ether, and when the muscles relax, there is little difficulty in reducing the dislocation. Cutting down upon the joint is very rarely, if ever, necessary.

Dislocations backward are very rare and are always attended with fracture of the anterior portion of the glenoid fossa of the temporal bone, or the tympanic plate. The external auditory canal, or the middle ear, may be infringed upon, and blood may escape from the external ear. There is no evidence that the articular disk is injured. These injuries are nearly always attended by concussion and severe shock. Because of the injury and inflammation of the joint proper, true ankylosis may follow. When intra-articular ankylosis results and movement of the joint cannot be restored, osteotomy of the neck of the condyle becomes necessary.

Pathological dislocation is caused by the alteration or distention of the tissues comprising the joint, by sepsis or by inflammatory exudates resulting from diseases, such as infectious arthritis, the febrile diseases, pneumonia and others. This is rarely, if ever, observed in the mandible.

Congenital dislocation is dependent upon a congenital deformity of the joint, which makes it impossible to retain the articular surfaces in their proper relative position. These types of cases have not been reported as occurring in the mandible.

CHAPTER XXI.

Ankylosis of the Temporomandibular Articulation.

Ankylosis is the partial or complete fixation of a joint, due to intra- or extra-articular alteration of tissues, resulting from injury or disease.

Ankylosis has been classified in different manner by different authors, according to the peculiarities which they present in different parts of the body. The following classification is not in any way original, but an attempt is made to include only those types of conditions which are in accord with the clinical and pathological findings in this joint.

(1) True or intra-articular ankylosis: In this there is an alteration of the tissues within the joint proper; the alteration may be fibrous but is more frequently osseous. (Fig. 328.) (2) False, or extra-articular ankylosis: In this the tissues external to the joint are altered or replaced by cicatricial tissue as a result of injury or disease. (Figs. 329 and 330.)

The term "false ankylosis" is sometimes also applied to those cases of trismus or temporary partial fixation of the jaws, which are so frequently met in acute inflammatory conditions caused by abscess due to infected or erupting third molars; or, to parotitis, tonsillar and peritonsillar abscesses. Furthermore, ankylosis is not to be confounded with other conditions in which the jaws are spasmodically closed, as in tetanus; or their movements limited as in hysteria, or by neurologic reflexes.

Etiology of Ankylosis.

The etiology of true or intra-articular ankylosis are: (1) Traumatic injuries of the mandible, transmitted to the glenoid fossa; (2) Extension of suppuration from the middle ear; (3) Mandibular osteitis extending to and involving the glenoid fossa; (4) Fracture of the condyle or the neck of the condyle from an external injury, as in posterior dislocation, which is followed by extensive callus formation; (5) Arthritis, as a part of involvement in a generalized arthritis, or this may be caused by metastasis from distant foci of infection.

In true bony ankylosis the condyle and the glenoid fossa become solidified by bony tissue formations. The ossification may also extend to the lower border of the zygomatic arch, and the coronoid process and the sigmoid fossa become welded to the zygoma.

FIG. 328. Intra-articular partial ankylosis which commenced at an early age. Note the underdeveloped mandible, the receding chin, and the tension of the hyoid muscles caused by the attempt to open the mouth. (From the collection of the Oral Surgery Department, Vanderbilt Clinic.)

An accurate diagnosis is important in the treatment of these cases and to obtain this is not always a simple matter. Attentive and detailed clinical examination and close inquiry into the past history should be supplemented with good radiographs.

FIG. 329. Cicatricial ankylosis in a woman about 50 years of age. This resulted from ulcerations following scarlet fever at an early age. The ankylosis was more caused by the fibrous bands which tied the upper and lower jaws together than by the facial scar.

There are some fairly definite diagnostic signs, which, if understood, aid materially in arriving at a diagnosis. In early cases, this is even more difficult as there is no, or but very slight, deformity; and the alteration of the tissues may be such that it cannot be demonstrated with radiographs, nor by clinical discernment. In those which occur in early childhood, there is usually a history of trauma sustained upon the chin, caused by a fall or a blow, and sometimes many months pass before the ankylosis becomes perceptible or complete and is discovered by the parents. As a result of such an injury, the capsular ligament becomes distended by the hemorrhage, or by inflammatory exudates, which may be followed by ossification.

When the ankylosis occurs in early life, the clinical appearance is of great diagnostic value: (1) There is a characteristic, conspicuous deformity of the face, marked by a receding chin and underdeveloped mandible. This underdevelopment, or aplasia, can be readily explained if we

FIG. 330. The same case as Fig. 329, showing the intra-oral cicatricial bands.

recall that the mandible grows in length from the epiphysis of the condyle and that the other four centers of ossification are united with bone before birth. Growth, therefore, is retarded or completely arrested by injury to, or ossification of the epiphysial line. Some authorities believe that this lack of development is due to atrophy because of lack of function. If atrophy is considered as a retrograde wasting or diminution of a part, this theory must give precedence to the former supposition. A lack of development is observed in all early cases. (2) For the same reason the ramus of the affected side may be slightly shorter and the angle of the mandible describes a rather obtuse angle. (3) The face on the affected side is full, rounded and appears to be normal. (4) The unaffected side appears flat and is of abnormal appearance, the flattening being most marked at the chin, and the chin may be slightly drawn over to the un-

affected side. (5) There is no movement whatever on attempting to open the mouth, in bilateral bony ankylosis. (6) In unilateral bony ankylosis, upon attempting to open the mouth there may be a slight separation of the teeth and a deviation towards the affected side. (7) Forced effort may bring the mandible slightly forward through the action of the muscles of the neck and upon this sliding motion the palpating finger may discern a slight movement of the condyle on the unaffected side. (8) Upon attempting to open the mouth the muscular activity is greater on the unaffected side. (9) The muscles on the affected side are more atrophied.

Treatment of True Ankylosis.

The treatment of true ankylosis, whether of fibrous or osseous nature, is essentially surgical. The attempt to establish motion by trying to change these altered conditions by means of wedging, forced movement, or therapeutic measures, avails little more than the loss of effort and time. Simple osteotomy is nearly always followed by bony union. More satisfactory results can be obtained by arthroplasty.

Of the various methods which have been used in the past for re-establishing motion in ankylosed or diseased joints, I shall mention those only which have been successfully used in the mandible and which find ready application in the treatment of this joint. These are: (1) Restoration of the mobility of a joint by the interposition of muscle or fibrous tissue between the separated surfaces; this was originally practiced by Helferich in 1893; (2) Transplantation of pedicled flaps or fascia and fat, establishing thereby a sliding movable joint. This was originally introduced by John B. Murphy, of Chicago,* with very gratifying results, in the treatment of the mandible, the hip, knee and elbow. This operation is the one which is in vogue at the present time; (3) Transplantation of free fat and fascia taken from distant parts of the body. This method is particularly indicated in those cases where a pedicled flap is not available, because of the pathological conditions preceding, or associated with the formation of the ankylosis; (4) The interposition of metallic substitutes or the transplantation of heterovisceral absorbable membranes, as practiced by Roser and Baer. Murphy states that any method which depends upon the insertion of heteroplastic foreign bodies must perish from this field of work and is foredoomed to failure. These substances, even when aseptic, must be supplanted with fibrous connective tissue, which may permit of some degree of motion, but will not provide a sliding movable joint, such as can be obtained with the use of an autoplastic pedicled flap.

* Murphy, John B., *Jour. A. M. A.*, June 6, 1914.

Technique of Operation for Ankylosis.

Briefly stated, the technique of the operation consists of the following steps: The temporal area of the affected side is shaved and the entire region is prepared, as any field of operation would be. An L-shaped skin incision is made, with its vertical limb in the hair line and about a quarter of an inch anteriorly of the external ear; the horizontal limb is made parallel with the upper border, or over the zygomatic arch. The tissues are freely retracted next and the joint and the upper part of the ramus are exposed through the subzygomatic region. Care should be exercised that the temporal artery, or the seventh or facial nerve, which makes its exit from the skull through the stylomastoid foramen and traverses the lower portion of the parotid gland, are not severed. This accident is sometimes inevitable, and when some of the fibers are divided, paralysis of the respective muscles of expression of the face follow. This may be only temporary, however. After the bone and the joint are clearly exposed, the neck of the condyle is divided by means of a Gigli saw, a bur, or chisel and mallet. In doing this, there is a danger of severing the internal maxillary artery, which is situated very close to the inner surface of the neck of the condyle. A portion of bone, one-half to five-eighths of an inch, is removed with its complete periosteum. Clearing out the glenoid fossa is not essential, and where this is attempted, there is a possibility of entering the base of the skull. A flap of the temporal fascia, fat and aponeurosis is raised next from over the temporal muscle. This is brought over the zygoma and tucked into the cavity created by the removal of the segment of bone, and is attached to the tissue laterally by means of two sutures. The final step is closure of the surface wound, dusting the line of incision with a dusting powder and applying a dressing.

After the operation, a wooden block is introduced between the molar teeth on the operated side, which Murphy advises to keep in place day and night for two weeks. This will prevent shifting of the mandible and pressure upon the flap of fat and fascia interposed between the separated bone surfaces. Mastication, or opening the mouth, is not attempted for at least two weeks.

The operation is not always followed by success. Frequent causes of failure are: (1) A part of the periosteum left in place, causing regeneration of bone. (2) The flap becomes necrosed because of pressure, excessive trauma, or because of infection, and the repair connective tissue becomes ossified. (3) The transplanted fat or fascia becomes absorbed and replaced by connective tissue which becomes ossified. (4) The after care is not carried out according to instructions.

Brophy Operation.

It may be quite in place here to mention the operation devised by Brophy,* for which he claims very good results. The angle of the mandible is exposed through an external opening, the line of incision being in the shadow line of the jaw. The mandible is divided next with a bur, by making a crescent shaped incision, which is carried from the posterior aspect of the third molar, through the angle of the jaw. The convexity of the crescent is towards the ramus; this to prevent displacement of the parts. A sheet of gutta-percha, 2 mm. thick, is interposed between the divided surfaces of bone to prevent their reuniting and the external wound is closed, leaving a small opening for drainage. The wound is kept clean and the gutta-percha is left in place for six weeks. After this time the raw bone surfaces become covered with connective tissue. The original incision is reopened, the gutta-percha is removed and the wound is closed. This operation commends itself because of its comparative simplicity, its freedom from complications and accidents. It must be evident, however, that a closer approximation to the original joint and a more normal function of the muscles can be obtained with arthroplasty.

False Ankylosis.

False or extra-articular or, as it is sometimes very appropriately called, interalveolar ankylosis, is established by the formation of cicatricial bands which may be lodged at any point between the symphysis and the posterior part of the oral cavity. They are more common in the molar and bicuspid regions and result from extensive ulcerations of the oral mucous membrane following typhoid and scarlet fever, measles, infections and extensive denudation of the alveolar processes; subzygomatic infections which may extend from the mouth, from the temporal fascia or from the scalp; also extensive destruction of tissue in cases of malignant growths or syphilitic gumma. The cicatrix is not always confined to the tissue of the oral cavity. In many instances the destruction of the oral mucosa extends to the surfaces of the face.

In the treatment of cicatricial ankylosis, favorable results cannot be obtained by merely severing the tissue bands which cause fixation of the jaws. With successive incisions, there is an increase of cicatricial tissue which rather tends to aggravate than to improve the condition. The reuniting of the severed bands or the denuded surfaces whence the cicatricial tissue has been removed, can best be prevented by covering these raw areas with mucous membrane or epithelial tissue. This can be secured by pedicled mucous membrane flaps as originally practiced by Murphy.**

* Brophy, *Oral Surgery*.

** Murphy, John B., *Jour. A. M. A.*, June 6, 1914.

The pedicled flaps are taken from the soft and hard palate or from the floor of the mouth and are secured by means of ligatures. The apposition of the tissue may be assisted by the pressure of sponges, or by fitting a portion of wax to conform with the vestibule of the mouth. Wolff grafts, taken from the thigh, or from the outer surface of the arm, have likewise been successfully used for the purpose. In these cases the transplanted tissue is sutured on to the denuded surface and held in close apposition by means of a portion of wax, moulded into conformity with the normal anatomical outline of the parts. The transplant soon takes on the characteristics of the oral mucosa.

CHAPTER XXII.

Ludwig's Angina.

Ludwig's angina is a severe, acute septic infection, characterized by a rapidly spreading edema, which involves the floor of the mouth, the submaxillary regions and the upper part of the neck.

The disease was first described by Ludwig of Stuttgart, whence it derives its name.

The etiological factor is a very virulent streptococcic infection which may be derived from a carious or infected tooth. The invasion may take place through a very slight abrasion or break in the continuity of the mucous membrane surface.

The bacteria reach the submaxillary regions probably through the lymph channels, and the glands usually become enlarged or even destroyed, after which the infection spreads along the connective tissue planes. The first points of induration are, as a rule, the regions of the submaxillary and sublingual glands. The disease usually runs a very rapid and violent course. In a variable time, within one or two days, the entire floor of the mouth becomes involved, and the edema spreads to the glottis, causing dyspnea, and when this occurs trachiotomy must be performed to save the patient from suffocation. Very frequently the induration and the edema become so extensive that the whole neck presents a hard, boardlike, browny, discolored swelling, and this may spread to the lower parts of the neck or even to the mediosternum. There may or may not be some ill-defined points of fluctuation. There is a marked or only a moderate rise of temperature.

The prognosis is not always favorable and there is high rate of mortality. When death occurs, this is not always due to septicemia but more frequently to edema of the glottis and bronchopneumonia.

Treatment. The treatment consists of prompt operative measures. The edematous areas are freely incised, both intra- and extra-orally. The incisions should be made judiciously to avoid severing some of the larger blood vessels which traverse these regions. The incisions are so communicated that thorough drainage is established, which is maintained with rubber drainage tubes. Antiseptic fomentations may be beneficial. Stimulants should be freely used when indicated.

CHAPTER XXIII.

Salivary Calculus. (Sialolithiasis.)

Salivary calculus as used here designates the formation of calcific concretions within the substance, or within the duct of a salivary gland.

The affection is comparatively rare but not quite so much so as the paucity of the reports of cases would indicate. My records show that during the past ten years I have seen and treated eight cases. None of these has been reported, principally because, despite the complications arising from them, they seemed to be of rather minor surgical or pathological interest.

The affection may occur at any age. Some few cases have been reported as early as five or six years of age, and also some as late as the ages between sixty and seventy. They may occur in any one of the salivary glands; the most frequently affected is the submaxillary; next, the sublingual, and finally the parotid gland.

Etiology of Salivary Calculus.

The etiology of the formation of these calcific deposits is rather obscure and beyond plausible surmises nothing really definite is known. The following theories have been advanced: (1) A foreign body such as a fishbone, a fragment of calculus from the teeth, a piece of straw or toothpick, may find entrance into the duct and form a nidus for the deposition of calcific salts. (2) Inflammation of the duct causes retention of the saliva and through some unknown chemical change, brought about by the inflammatory condition, some of the calcium salts are precipitated. (3) Clumps or aggregation of microörganism may find their entrance into the duct and form the nidus for the deposition of the calcific salts. (4) Retention of the saliva causes a chemical change and precipitation of some of the calcific salts, which may be retained in the inflamed and constricted lumen of the duct.

The external form of these concretions suggests that they may develop in a portion of the gland proper, in which event they are irregular in outline and not easily dislodged. Others are cylindrical and ovoid in form, indicating that they were deposited in the duct. Those which are deposited in the duct are as a rule cylindrical in shape, more or less ovoid in outline, and vary in length and thickness. The substance consists chiefly of in-

organic salts, calcium phosphate and carbonate, and may also contain numerous organisms and some organic matter.

Symptoms. The symptoms usually vary to a degree with the nature of the obstruction of the gland and with the gland involved.

They may be divided into two stages. In the first stage, when the calculus is very likely small, there may be periodical irritation, inflammation, and an ill-defined sense of discomfort in the region of the affected gland. There may also be a degree of periodical swelling in the sublingual and the submaxillary regions. The swelling usually increases when eating, or when the sight of food induces a freer flow of saliva. This simply indicates that saliva cannot escape through the obstructed duct, is dammed back, and the gland becomes distended. These symptoms persist often for many months before the patient may become discommoded to such an extent that medical advice is sought.

The second stage is marked with somewhat more disturbing symptoms. The swelling, though fluctuating in size, is fairly constant. Suppuration ensues. There is, as a rule, a marked inflammation, and the tissues underneath the tongue become indurated, presenting a ridge over the direct region of the calculus. The calculus may be felt by manual palpation. Suppuration of a varying degree may likewise ensue, which may discharge freely from the orifice of the inflamed duct. There may be considerable swelling and induration of the base of the tongue, and also a swelling which may be seen in the submaxillary region. Often retention of the pus may take place; the pressure causes considerable pain and there are toxic symptoms and rise of temperature.

In diagnosing, the case may be mistaken for a sublingual abscess, for lymphadenitis, tuberculosis, syphilis, or malignancy of the affected gland. It may sometimes be mistaken for a ranula. The absence of inflammation and disturbing symptoms easily differentiates it from the latter disease. In the parotid gland there is considerable swelling of the face because of the distention of the gland, and pain due to the unyielding, tense capsule enveloping this gland. Here it may be mistaken for mumps, cystic degeneration, syphilis or malignancy.

That the diagnosis is not always easily made, is indicated by the fact that numerous cases reported, and some treated by me, were under medical care for some time before the true cause of the disturbance was discovered. One of the cases illustrates this well. A boy nine years of age had been complaining for about six months of periodical pain and swelling in the right submaxillary and sublingual region. After about three months, a filled first molar was removed as the suspected source of the complaint,

and because the now chronic abscess was evacuating through this point. The removal of the tooth did not seem to influence the symptoms. Upon examination I found that the tissues in the sublingual region of the affected side were considerably indurated, and that pus escaped upon pressure

FIG. 331. Radiographic expression of salivary calculus. The film is on the occlusal plane, and the rays are directed from below the chin, upward.

through a small orifice. A blunt silver probe was introduced through the point where the pus escaped, and very soon a solid, gritty mass was encountered within the duct. Probing through the duct is a very good means of ascertaining the presence of a calculus, but care must be taken that it is not pushed into the interior of the gland.

The radiograph is also an unmistakable guide, when the obstructing body is large enough to be demonstrated by this means. A lateral exposure is not always satisfactory as the calculus is not more radiopaque than the bone and it may be thus overshadowed. A better method is to introduce one of the larger films as far back as the posterior part of the mouth permits. The patient is made to bite upon this, the head is thrown back as far as possible and the exposure is made from underneath the chin, the rays being directed parallel or nearly parallel with the long axis of the teeth. (Fig. 331.) This secures a well-defined picture of the floor of the mouth and the presence of a calculus is disclosed.

Treatment. The treatment consists in the main in the removal of the calculus, which usually terminates all symptoms. Upon the removal, considerable pus and thick, ropy saliva may be evacuated. Smaller stones may be passed through with finger manipulation by merely distending the orifice of the duct with a probe. In larger ones, or when the calculus is within the gland, the overlying tissue must be slit. Whenever possible this should be avoided, to prevent complete or partial cicatricial stenosis. It should be observed whether there are multiple stones, or, when one is broken, all particles should be carefully removed. In almost all adult cases this can be done under local anesthesia. In young or intractable children a general anesthetic must be used.

The postoperative treatment consists of a general hygiene of the mouth by means of a mild antiseptic mouthwash. As a rule there are no complications.

CHAPTER XXIV.

Leucoplakia Buccalis.

Leucoplakia may be regarded as keratosis of epithelial tissue which may affect almost any part of the oral mucosa. It is most frequently observed upon the dorsum, spreading in some cases to the sides but very rarely to the under surface of the tongue. Other parts which are sometimes affected are the buccal parietes, the inner surfaces of the lips, and even the pharynx is not immune.

The keratosis usually appears in the form of smaller and larger, well circumscribed or irregularly outlined, milkish white, or grayish, glistening patches. Those occurring upon the mucosa of the cheeks are prone to appear raised, while those occurring upon the dorsum of the tongue often appear as depressed and desquamated surfaces. There are other cases which, in outline or in general appearance, do not correspond to the classical descriptions given in most text books.

The case presented in Fig. 332 is atypical in many respects. This occurred in an Italian laborer, sixty-five years of age. He was a moderate smoker and a moderate drinker of light wines. There was no luetic history, and the Wassermann test was negative, even after provocative treatment. His mouth was generally in a neglected state and had only a few broken down and diseased teeth. The condition was noticed for some years, but, as there were no disturbing symptoms, very little attention was given to it. About six months before this, a degree of glositis developed, so that pain was experienced upon moving the tongue and food of every kind caused a degree of irritation.

Upon examination, I found that the entire dorsum, back to the circumvallate papillæ, and the sides of the tongue, were covered with thick, fuzzy keratosis. It seemed as though the papillæ had become elongated and hornified. He was unable to project, or turn his tongue, up to the roof of his mouth. There were no fissures, cracks, nor signs of any kind to indicate malignant degeneration. The condition was treated with radium, through which the keratosis was removed so completely, that the tongue was entirely devoid of papillæ, and the mucous membrane appeared to be highly colored, very thin, glistening, and was exceedingly sensitive. There

FIG. 332. Leucoplakia of the tongue in a man 65 years of age. Note to what extent the tongue is involved, the keratosis penetrating even to the under surface of the tongue.

were no fissures, ulcerations, nor breaks in the continuity of the surface, nor other signs of degeneration. This condition persisted for six months, after which the patient was lost track of.

Etiology of Leucoplakia.

The etiology of leucoplakia is obscure. The popular belief is that it is caused by some kind of chronic irritation, such as the use of tobacco, of alcohol or highly spiced foods. This assumption was largely founded upon the observations that they more frequently occurred in heavy smokers and very few cases in women have been reported. For some time it was believed to be the product of a syphilitic soil. This theory has been abandoned, as in the largest per cent of cases, the presence of syphilis could not be proven.

The seriousness of leucoplakia lies in the fact that it is recognized to be a precancerous condition. Especially those of the tongue have the tendency to form fissures, or they may ulcerate and undergo malignant degeneration. It is advisable to instruct these patients to return for observation at stated intervals. Upon the first sign of degeneration, the part of the tongue bearing the patch should be excised, before a positive cancerous condition develops. To treat with caustics or silver nitrate, at any stage, is just courting trouble. When there is reason to believe that malignancy has developed, the operation must be more radical.

The treatment should be principally preventive. The patient is instructed to abstain from smoking, the use of alcoholic drinks, and all spicy and irritating food substances.

The prognosis is not essentially alarming. About twenty to thirty per cent of the reported cases have been found to undergo malignant degeneration. When epithelioma develops the chances of recovery is in a ratio with other cases of malignancy of the tongue.

CHAPTER XXV.

Neoplasms of the Oral Cavity.

The subject of neoplastic diseases in general is so broad in its scope, and so overwhelmingly important, that it is my opinion that whoever assumes the responsibility for their diagnosis, or undertakes their treatment surgically, or by therapeutic means, must have more than a mere passing knowledge of the subject.

With this view in mind, it is beyond the scope of this book to deal with the topic in this broader and comprehensive manner. To do justice to the subject, it is essential that one should acquaint himself, as far as possible, with the pertinent literature extant in the text books, and also the individual contributions published in different periodicals. I should like to point out in this connection that reading knowledge alone is entirely inadequate to a clearer comprehension of the different phases and often confusing clinical aspects which individual cases may present. Nor are laboratory findings, even in the hands of expert pathologists, always reliable. On more than one occasion it has been my experience, as well as that of others, that specimens deliberately taken from a neoplasm were returned with the diagnosis, "inflammatory tissue." A reliable diagnosis and treatment must be based upon prolonged and close clinical observations and study of individual cases. This should be combined with a comparison of the laboratory findings, observations and well-kept data followed up for a period of years, after treatment has terminated.

Definition of Neoplasms.

A neoplasm may be defined as the proliferation of new tissue which is autonomous in its growth and which shows no purpose in structure nor of function.

Etiology of Neoplasms.

The etiology of neoplasms is, today, nearly as much of an enigma as it has been in the past. A number of old theories have become obsolete and been discarded. A number which still survive are the subject of controversy and are partly retained, because they contain some elements which provide a workable hypothesis. Through the extensive experimental research and the investigations by specifically endowed institutions for cancer research, also because of the more accurately kept data and the statistics based thereon, we learn more and more definite facts about the etiological

factors, and these scientifically conducted observations will bring us, in the course of time let us hope, nearer to the solution of the subject.

Of the prevailing theories regarding the etiology we may mention the following: Misplaced embryonal cells which begin to develop, as with advanced age the physiological restraint normally controlling tissue growth is released; the inciting of dormant embryonal cells to greater activity; aberration of function with a concomitant power for greater proliferation.*

The most widely known hypothesis for the etiology is generally credited to Cohnheim. This assumes the existence of embryonic groups of cells in the body, which, under some unknown circumstances, are propelled to over-active proliferation. This theory was formulated upon Virchow's law that "every cell comes from a pre-existing cell." Cohnheim failed to point out just what these activating forces are and his hypothesis was further elaborated by Ribbert. Ribbert holds that the process can be explained best by the assumption that in the formation of an epithelioma the epithelial cells prepare the soil into which they later penetrate. Hauser believes that an epithelioma or carcinoma can originate only through a fundamental change in the biological properties of the implicated cells.

From these, and numerous other propounded theories, it is clear that the true etiological factor still remains undiscovered. We do have, however, some very definite information as to specific conditions with which neoplasms are found to be associated. Ewing points out, in this connection, that heredity may be one of the predisposing factors.** Also, types of growths have been noted to be prevalent in certain occupations or under circumstances where habits produced points of irritation. Ewing also states that, notwithstanding the generally observed cell autonomy, "it may be almost said that the etiology of each form of tumor is specific, and that a practical knowledge of tumor etiology requires a minute analysis of all the factors in each case."

Relation of Teeth to Cancer.

It is probable that it is with this view in mind that, at a recent meeting, Bloodgood made the sweeping statement that cancer of the mouth is a preventable disease. On this occasion he pointed out, also, that people who keep their teeth well attended rarely develop cancer, but that it is almost invariably observed in filthy mouths, or in patients who wear ill-fitting dentures. Those people whose teeth are kept in a healthy, clean and smooth condition are comparatively immune. Unquestionably, there are exceptions to this rule. My own recollection, of the numerous

* Delafield and Prudden, F. C. Wood, *Text Book of Pathology.*
** Ewing, *Neoplastic Diseases.*

cases which I have seen, is that in almost every instance of malignancy, the teeth were in a very dilapidated, and mouth in a generally filthy, condition.

In neoplastic growths about the oral cavity we recognize therefore that the specific etiological factors are trauma, and some form of constant or repeated irritation. Judd * states,—"An old, broken or roughened tooth, in constant contact with the border of the tongue, may result in ulcer formation and later epithelioma." Broders (quoted by Judd) is inclined to believe that smoking, as an etiological factor in the production of a lesion upon lip or tongue, is considerably overestimated.

Symposium on Carcinoma.

In the February, 1923, issue of *Surgery, Gynecology and Obstetrics*, there appears a symposium on carcinoma of the jaws, tongue, cheek and lips. The contributions come from some of the most noted surgeons, with many years of experience in this field:—Crile, Judd, New, Brewer, Ochsner, and Blair. The compilations presented contain, besides personal experiences, statistics derived from other creditable sources here and abroad. From the perusal of this article one is impressed with the gravity of the malady, and that although numerous cures are reported, the prognosis at best offers a rather dismal outlook.

There seems to be a concurrence of opinion that the malady can often be prevented if recognized in the precancerous stage, as an ulcer upon the tongue, a fissure or point of irritation upon the lip, leucoplakia in its early stages of degeneration, etc. In the early stages of cancerous degeneration a cure may be definitely expected. It is very unfortunate that those who are afflicted with the malady, often through sheer negligence, through ignorance, or because of the absence of disturbing symptoms, apply for treatment only when the growth has attained an advanced or inoperable stage. That professional meddling is often the cause of delay is not infrequently observed. Blair, in the above cited article, makes the following statement: "Fifty per cent of all carcinoma of the mouth could be eliminated in the precancerous stage."

E. S. Judd.

Further quotations from the above stated article are of more than passing interest from a surgical standpoint. "It is the duty of every physician and dentist who is consulted with regard to an apparently insignificant lesion, completely to remove the lesion and to determine its exact character as early as possible. If the ulcer has been treated locally, a report of inflammatory tissue from the pathologist should not be considered absolute."

* Judd, *Surgery, Gynecology and Obstetrics*, February, 1923.

A. J. Ochsner. "I agree with Judd's objection to temporising and local treatment with silver nitrate, iodin or other remedies until secondary involvement of the lymph nodes has occurred. Early diagnosis and radical operation with the cautery should be insisted upon." Ochsner further makes the following conclusions:—

(1) "Cancer of the jaw is usually preceded by some form of irritation (mechanical) or trauma, caused by decayed teeth, ill-fitting plates, etc.
(2) "Inflammation due to unclean or infected conditions usually precedes the cancer formation.
(3) "The growths are characterized by slowness in invading the surrounding tissues.
(4) "They fail to produce metastasis in remote organs.
(5) "Incomplete operations are followed by immediate recurrence and rapid increase of growth, regardless of secondary operations and X-ray or radium treatment.
(6) "Insufficient radiation seems to have the same harmful effect.
(7) "The best results are obtained from very thorough, early operation with the cautery iron, destroying at least one centimeter of apparently healthy tissue of the surrounding area. The rule is, destroy as much tissue in the primary operation as we would naturally expect to destroy after the first recurrence."

George W. Crile. "When death occurs from cancer of the head and neck, it is because of local and regional development of the disease and not because of distant invasion. The collar of lymphatics about the neck forms an almost impassable barrier through which cancer rarely penetrates. Every portion of this barrier is accessible to the surgeon. In 4500 reported cases of autopsy, in only one per cent were there secondary foci in distant organs." His conclusions are in part:—

(1) "The primary focus may be destroyed by cautery or removed by excision.
(2) "Local excision of only the primary focus of the tongue, lip and the floor of the mouth, leaving regional lymphatic glands, is as ineffectual as excision of the breast without removal of the regional glands.
(3) "Excision of individual lymphatic glands not only does not afford permanent cure, but is usually followed by greater dissemination and more rapid growth.

(4) "The logical technique is a complete block excision of the regional lymphatic system, together with a wide excision of the primary focus.

(5) "A single treatment with deep, accurately measured X-ray or radium dosage is employed after operation."

Whatever their location or their point of origin may be, tumors may be loosely classified as being,—(1) benign, (2) malignant.

Benign tumors are characterized as follows:—

(1) They proliferate slowly, although there may be periods in their life history during which they increase very rapidly after considerable seeming inactivity. Some may attain so large a size that they infringe upon the surrounding tissues or structures.
(2) They enlarge through a multiplication of their own cells rather than by the invasion of the adjacent and subjacent tissues.
(3) They do not metastasize.
(4) They do not recur if thoroughly removed.

Malignant growths are characterized as follows:—

(1) They show rapid growth.
(2) They infiltrate the surrounding tissues and the invasion may progress without limitation until the patient dies.
(3) They metastasize; the secondary growths may appear in the vicinity of the original growth, or at some remote point.
(4) They tend to recur after removal.

Diagnosis of Neoplasms.

In the clinical study and diagnosis of a neoplasm observe:—the anatomical location; the clinical appearance; the relation to adjacent tissues; the histological structure, or better, the apparent texture. Determine the tissues from which it springs; the period of growth, or the life history; the presence of involvement of the glands when this can be determined by gentle palpation; the possible reaction upon the entire organism.

Other diagnostic considerations are: Age: Sarcoma of the jaws is more commonly found in younger patients, before thirty-five or forty, though some authorities place this at fifty. Carcinoma of the jaws is more frequent between the ages of fifty and seventy. Adamantinoma is usually observed between the ages of twenty and forty. Sex: Epuloid growths are more frequently observed in women while carcinoma of the oral cavity is more common in men.

In the examination of neoplasms, it is very strongly advised not to subject the tumor to palpation when this can be avoided. Palpation may

disengage some of the neoplastic cells, which may be carried to remoter areas through the channels of communication (Tizzer). It is equally ill advised to cut into a tumor, or to remove a portion of it for examination. It has been pointed out that even the finest blade of a knife may detach a few neoplastic cells, which may be transported to distant parts through

Fig. 333. Inflammatory hyperplasia caused by an ill-fitting plate. The patient was 56 years old and had worn her first plate for the past twenty or thirty years. Note the numerous invaginations which may give the impression of malignancy. There was no complication after removal.

the severed blood and lymph vessels. If a tumor gives a history of having existed for several years, it is probable that it was not malignant at its origin or that it is not malignant. But when there is a sudden propulsion of rapid growth it is probable that there is a malignant degeneration.

The classification of tumors is largely dependent upon their resemblance to certain types of tissue with which they are not entirely identical. However, other classifications are regional and etiological. This vague classification is not always applicable, as there are tumors of the malignant type which do not resemble any normal tissue (Ewing).

For our purposes it will be the simplest and most satisfactory method, therefore, to classify the tumors of the oral cavity on a histological basis:

FIG. 334. Inflammatory hyperplasia in a woman 45 years of age. Note here also the number of folds of tissue indicating the progressive absorption of the alveolar bone and the compensating tissue formation.

FIG. 335. Inflammatory hyperplasia of the lower jaw in a woman 46 years of age. The growth was continuous with a fibrous tissue band posteriorly, which likewise had to be removed to make it possible for her to wear a plate. She had worn her first plate for over twenty years.

(1) The connective tissue type:—Fibroma; epuloids; osteoma; angioma; sarcoma; chondroma; lipoma; odontoma.

(2) Of the epithelial tissue types there are: Epithelioma; carcinoma; adamantine epithelioma. (This probably is a mixed tumor.)

Inflammatory Hyperplasia of the Oral Mucosa.

Inflammatory hyperplasia of the oral mucosa, as illustrated in the figures 333, 334 and 335, are comparatively rare conditions. They spring from the labial and buccal mucosa and the alveolar mucoperiosteum, as the result of irritation caused by an ill-fitting plate. While their appearance rather suggests that of a new growth, they are not neoplasms in the true sense of this term, and are always benign in character. I present these in this chapter because of their appearance, as they may be mistaken for a neoplastic growth.

The clinical appearance and the history of these cases suggests the following cause for and course of their development. The removal of teeth is always followed by shrinkage and absorption of the alveolar process and the overlying mucous membrane. The degree of shrinkage and the period through which this takes place varies in different individuals. When an artificial denture is inserted soon after the removal of the teeth, with this shrinkage of the tissues a space is formed between the alveolar ridge and the plate. At this period, it is desirable to modify the denture to meet the existing conditions, or to replace it with a new one. Where this is neglected a point of irritation is established which, though not intense enough to cause actual discomfort, may in some individuals incite tissue proliferation. Under these conditions the overhanging tissues sag into and conform to the space. With further shrinkage a second lobe may form, accommodating itself to the existing conditions, and in this way I have seen cases in which one, two, three, and even four layers or folds of tissues have formed and the plate while containing this exuberant tissue was but insecurely retained. In some cases this proliferation is limited to smaller areas. There are others, however, where the entire alveolar ridge becomes involved and sometimes even mars and displaces the lips.

The mass of new tissue is always covered with normal mucous membrane, and, beyond the invaginations of the different lobes, presents no signs of inflammation and there is no tendency towards hemorrhage. The patient is eventually disconcerted by the insecure retention of the artificial denture, and the condition is discovered by the dentist. In some cases the condition is discovered and relief is sought ten, fifteen, or even twenty years after the insertion of the artificial denture. This implies that the

irritation must have existed through a period of years with no sign of malignancy, nor tendency towards a malignant degeneration. It is impossible to state whether such degeneration would occur in the course of time.

The condition is corrected by the removal of the hypertrophied tissues in conformity with the normal alveolar ridge. In this, care must be taken

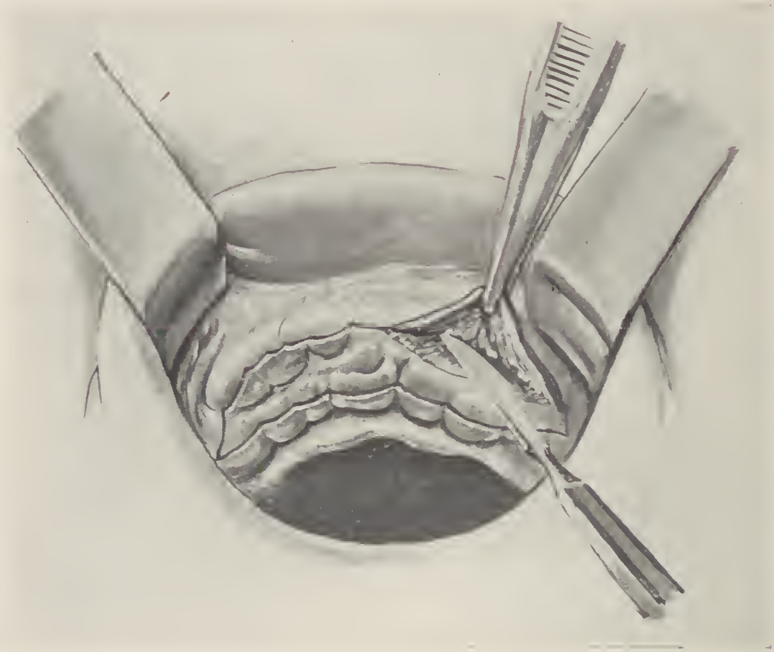


FIG. 336. Shows the incision to dissect away the lowest and the uppermost surface of the mucosa, for the removal of hypertrophied tissue.

so that the resulting cicatrix is reduced to the minimum. Extensive, tough, cicatricial tissue bands render the lips inflexible, and materially interfere with the retention of the artificial denture later.

Operative Treatment. Simple excision of the mass of tissue often creates this condition. Better results are obtained by the following method: The mucous membrane is dissected down from the upper and lower surface of the growth close to the bone (Fig. 336) and the bulk of the growth which is now lodged between the two flaps of mucous membrane is removed (Fig. 337 a. b. c.). It will be found that it consists mainly of connective tissue bands which may run parallel or may be interlacing, and are abundantly interspersed

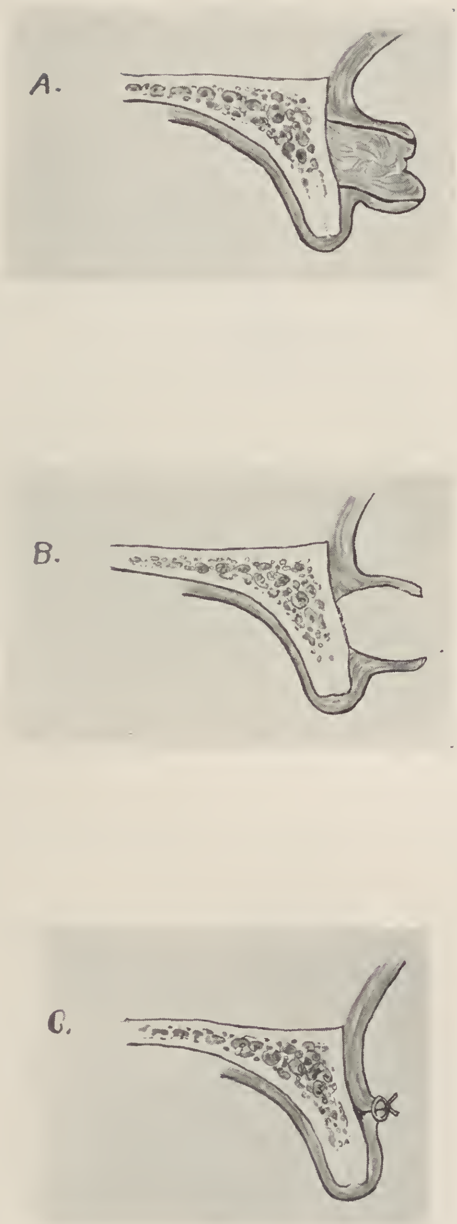


Fig. 337. A, B and C are diagrams showing the successive steps in the operation.

with adipose tissue. The blood supply is frequently quite rich, especially in the anterior part of the mouth. The severed blood vessels should be secured with catgut ligatures, to avoid undue ecchymosis or other complications. The hypertrophied tissue is completely dissected away, close

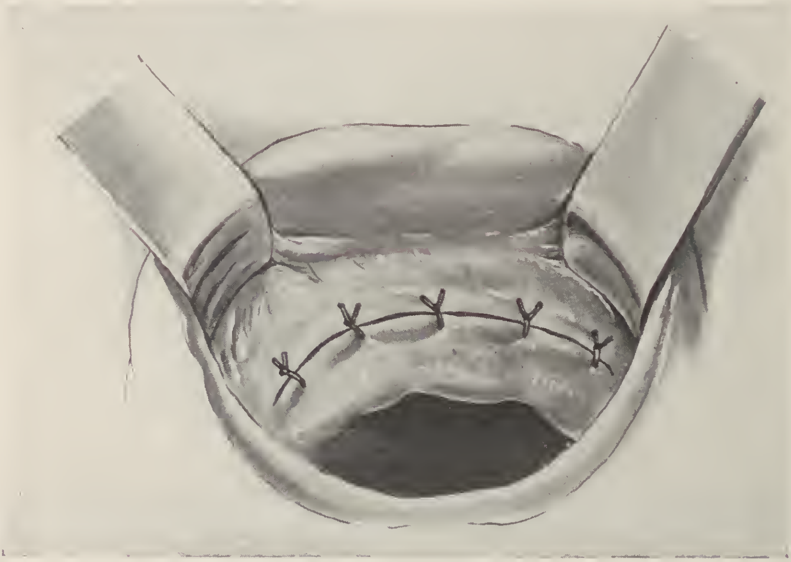


FIG. 338. Shows the mucous membrane flaps trimmed and sutured into place.

to the bone, and the mucous membrane flaps approximated. The surplus of mucous membrane is trimmed away and, whenever conditions permit, the flap nearest to the alveolar ridge is carried about two thirds over the area to be covered. By so doing a higher alveolar ridge is produced and the too low attachment of the labial and buccal tissues prevented. The flaps are sutured with fine catgut or horse-hair, with interrupted sutures. (Fig. 338.)

Where the condition is such that the labial or buccal flap of mucous membrane must be utilized, to prevent the formation of too short a ridge, it can be depressed with modelling compound adapted to the denture or may be held in place by the approximation of the jaws.

After forty-eight hours this appliance may be discarded, and the sutures are removed four or five days after the operation as these conditions usually heal by first intention.

Epulis.

Epulis is a benign growth which, as the term implies, appears on the gums about the teeth, or upon the alveolar ridges. Epulides more frequently spring, however, from the peridental membrane of a tooth to which they seem to be often attached. In many instances they are observed in parts which have been edentulous for a number of years.

Not unlike other neoplasms about the oral cavity, their formation can almost invariably be traced to some prolonged and constant irritation. The most frequent, apparent, etiological factors are: Calcific deposits about the teeth; broken-down teeth and the jagged edges of carious teeth dipping down into the gum tissues; ill-fitting dentures, clasps, bridges; overhanging fillings; and sharp portions of the alveolar process following the removal of teeth. I have seen numerous cases of epuloid growths where there was no apparent irritating factor which appeared upon the labial surfaces of the anterior sound and clean teeth in young subjects (Fig. 339). The most frequent site for their occurrence is the anterior part of the upper jaw, the incisor and the bicuspid regions. They occur more often in women than in men. Women, during the period of pregnancy or lactation, are particularly prone to develop these growths, and I have seen a number of cases which markedly decreased in size, or entirely disappeared, upon the termination of this period.

Epuloid growths vary in size, the average size being from three to four centimeters in diameter. There are many which are considerably smaller, and again some very much larger ones have been reported.

While epulides are usually regarded to be distinctly benign growths, there are some which manifest malignant characteristics, and they may undergo a malignant degeneration.

Epuloid growths are generally grouped into two classes: (1) The fibromatous, (2) the sarcomatous. This differentiation is based upon the distinctiveness of their clinical appearance, their tendency towards recurrence after removal and the histological structure. The sarcomatous types are also known as giant cell sarcomas.

Fibromatous Epulides. Fibromatous epulis is more frequently observed to grow upon the buccal or labial aspect of the teeth. Some seem to grow from the periosteum within the interdental spaces, and, separating the teeth, they straddle the alveolar ridge. Still others seem to be confined to the palatal aspect. They almost invariably appear to spring from a constricted base, and spread out in a mushroom-like fashion; i. e., they are pedunculated. (Figs. 340, 341 and 342.) They are covered with what appears to be a continuation of the

Fig. 339. Fibromatous epulis in a young woman 19 years of age. It originated from the mucoperiosteum and peridental membrane of the bicuspid teeth. The second bicuspid was entirely and the first bicuspid was but partly covered by the growth. Both of these teeth were free from pathological lesions. The source of irritation could not be determined as the entire mouth was well cared for and clean.

FIG. 340. Fibromatous epulis in a woman 40 years of age. The growth was not observed until about 3 or 4 weeks prior to the consultation. It arose from the alveolus of the crowned cuspid tooth. The irritation of the crown most likely induced the growth. Note the smooth surface of the growth.

FIG. 341. Fibromatous epulis in a woman 20 years of age. The growth was first noticed about three months ago. It arose from about the roots of a broken down bicuspid tooth which it covers. It straddled the alveolar bone and the mass of the growth was fairly uniformly divided on the lingual and buccal aspect.

FIG. 342. Fibromatous epulis in a woman 42 years of age. This was growing about an ill-fitting crown bearing a bridge.

normal mucous membrane and do not have a tendency to bleed, except in those cases where they extend over the biting surface of the teeth, and the irritation of the cusps beneath, or those of the opposing teeth, causes laceration of the surface of the growth.

Fig. 343. Sarcomatous epulis in a woman 35 years of age. The two bicuspids, the cuspid and the first molar were involved. Note the lobulated and pitted surface of the growth. It was of a deep red color and bled readily. The pathological report was that of giant cell sarcoma.

Sarcomatous Epulides. The sarcomatous types are very similar in their behavior and in their etiology, but they present a somewhat different clinical picture and prognosis. These growths usually spring from a broader base; there may be a slight degree of infiltration and destruction of the subjacent structure. The outer layer of tissue presents numerous furrows and invaginations, and the surface appearance is granular or like that of a strawberry. They vary in color from a bright inflammatory red to a deep cyanotic hue. They have a great tendency to bleed and to recur if not thoroughly extirpated. (Figs. 343 and 344.)

FIG. 344. Sarcomatous epulis in the lower right bicuspid region in a woman 45 years of age. The neoplasm grew over the jagged edges of the alveolus where the teeth had been extracted several years ago. The growth was deep red and in some parts cyanotic blue in color. Note the lobulations and the broad base from which it springs.

Treatment of Epulis.

The treatment of epulis consists of the complete surgical extirpation of the growth. It is probable that some men are driven to pessimism by the insidiousness of neoplasms in general, and therefore they advocate and practice what, in my estimation, are ultra-radical measures in many instances. They advocate the removal of a number of teeth in all cases, and also a goodly portion of alveolar bone, to prevent recurrence. I have found that when the diagnosis is definitely that of fibromatous epulis, these aggressive measures are not always necessary. I have removed numbers of smaller and larger epuloid growths, leaving all good teeth within the region intact. Many of these cases were followed up for five years and even longer, and there was no recurrence. When the teeth are not diseased and the pericementum and the alveolar process present no clinical or radiographic signs of infiltration or deterioration, they can often be safely retained. It is essential, however, that all the tissues which appear to form the bed of the growth should be eradicated. Where the teeth are diseased, devitalized, crowned, or contain larger fillings, they should be removed together with the larger part of the alveolus.

With a sharp knife or cautery the growth is circumscribed, the incision being carried well beyond what appears to be the base of the growth and down to the bone. This incision is carried through on both the labial and the palatal surfaces. All tissues thus circumscribed are raised from the bone, together with the periosteum. When the bone is exposed, every vestige of the periosteum and sharp or deteriorated portions of bone at the site of the growth are removed.

In the sarcomatous types, our measures must be considerably more radical. The removal of the growth should include also a goodly portion of the underlying bone; also the teeth which are implicated in the growth.

Within the past number of years I have been using the actual cautery in the removal of all benign neoplasms about the oral cavity, although, I must admit, that for a number of years I used the knife and blunt dissection in most cases with excellent results. I have adopted the use of the cautery because in a way it is often simpler to use, and also because of the degree of safety which it offers.

Fibroma.

Fibroma is a benign growth and consists chiefly of dense and sometimes lobulated masses of connective tissue.

Fibroma of the jaw, which is comparatively rare, may occur in the upper as well as in the lower jaw. It may originate in the periosteum of the bone, on the alveolar ridges, or may spring from the inner substance

Fig. 345. Fibroma of the lower jaw which occurred in a young woman 23 years of age. There was the history of having had two loose teeth removed two years prior to the time when this radiograph was taken. The first sign of swelling appeared about three months before. The growth was diagnosed to be a cyst, as it presented clinically, in its life history and in the radiograph, the characteristics of this growth. The growth was completely incapsulated, dense and hard in substance and the pathological report was that of fibroma.

FIG. 346. Small growth such as is sometimes seen in different parts of the vestibule of the mouth, or near the lips.

of the bone. It may reach quite a large size and some cases that have been reported have attained such dimensions that they caused a marked destruction of the invaded region and distorted facial symmetry, causing deformity. Nasal polypi and also those frequently found in chronic affections of the maxillary sinuses are classed as fibromatous growths.

When developing in the maxillæ or in the mandible the bone becomes distended and thinned out at the point of the growth. In this they often resemble cysts. As a rule they are painless unless some nerve trunk is pressed upon. In the diagnosis we must differentiate them from cysts and sarcoma.

The one case which came under my observation occurred in a young woman twenty-three years of age. (Fig. 345.) The two missing molars had been removed about two years before this radiograph was taken. There were no disturbing symptoms then, except that the teeth were loose. At this time, there was a marked non-inflammatory swelling of the mandible, and the bone crepitated at some points upon pressure. The pain was negligible and periodical. The growth presented all the clinical, historical and radiographic characteristics of a cyst. The first information of the neoplastic nature of the growth was obtained upon aspiration. In operating, it was found that the growth was completely incapsulated and could be practically shelled out like a cyst sac.

The gross appearance of the tissue upon section was that of closely packed, gritty masses of fibrous tissue. The pathological report confirmed this diagnosis and it was reported to be a fibroma. In the operation, no invasion beyond the capsule was discerned, although a large part of the body of the mandible had been destroyed. The case was operated on seven years ago. The patient was last seen five years after the operation, at which time there was no sign of recurrence, and the patient was well.

Smaller and larger growths such as illustrated in Fig. 346 are sometimes observed in different parts of the vestibule of the mouth, or near the lips. They are not inflamed and present no disturbing symptoms except when they are traumatized in chewing. The mucous membrane is intact and the growth is freely movable within the tissues. It is roundish in outline and hard and painless upon palpation. When the overlying mucosa is split it can be readily separated from the surrounding tissues. Macroscopically it appears as a white fibrous tissue mass and pathological examination shows that it consists of fibrous tissue.

Other Benign Growths.

Osteoma is a benign growth which consists most often of compact bone tissue. These tumors occur very rarely about the jaws, and they are to

be differentiated from other hyperplastic conditions, such as we often find following inflammatory conditions about the jaws. They are also to be differentiated from those congenital exostoses which appear as excrescences in the maxilla at the tuberosity and upon the palate, or upon the inner surfaces of the mandible.

True osteoma may develop in the upper or in the lower jaw, in the maxillary sinus, and in some instances they attain considerable size infringing upon important structures in their region, or they may spread and involve a complete surface of the bone.

Lipoma is a benign growth consisting chiefly of fat and connective tissue. Lipomas usually occur in the submucosa of the sublingual region, upon the tongue or at some other point of the oral cavity. They grow very slowly but may attain considerable size, so that they may interfere with function, when removal becomes necessary. They occur but very rarely in the oral cavity. Only a very few cases have been reported.

Angioma is a tumor consisting of vessels. Two different types are known: the hemangioma and the lymphangioma.

Hemangioma is made up of newly formed blood vessels. Of these two types are differentiated: (1) the simple or capillary (tellengiactasis), (2) cavernous angioma.

Sarcoma.

Sarcoma is a malignant neoplasm composed chiefly of connective tissue type of cells.

Sarcomatous growths may occur in any part of the mandible, in the maxillæ, upon the alveolar ridges, in the maxillary sinus, in the salivary glands, and some few cases have been reported which developed upon the tongue. Sarcomas are generally observed to grow in younger patients, but, in the jaws, they occur comparatively rarely in young children. I have seen some cases in children between the ages of seven and ten or twelve and also some at the ages of fifty and fifty-five.

Sarcomas may develop from the periosteum, from the bone substance, from the medulla, and from the blood and lymph vessels.

In pathological examination, three varieties are differentiated based upon the histological cell forms of the tissues; the giant cell; the spindle-shaped; and the round-cell sarcoma. The spindle-shaped and the round-cell types are classed amongst the most malignant tumors known. These develop and metastasize very rapidly; often with fatal termination.

Sarcomatous growths in general are also classified in keeping with the tissues from which they appear to spring, as—osteosarcoma, fibrosarcoma, chondrosarcoma, lymphosarcoma, etc.

Fig. 347. Sarcoma in the region of the lower left bicuspids in a child 7 years of age. The overlying mucosa appeared to be normal, and the only symptom was a slight swelling discovered by the dentist. Note how the partly developed bicuspids are displaced and also the apparently circumscribed invasion of the bone. Compare this with the radiograph of the opposite side. Fig. 348.

Fig. 348. The same case as Fig. 347, showing the well side of the same patient.

No satisfactory classification has as yet been offered whereby all sarcomatous growths could be distinctively classified from a pathological standpoint. Our present classification is largely based upon their clinical and histological appearances and the tissues from which they appear to be

FIG. 349. Sarcoma of the mandible in a boy 11 years of age. Note the circumscribed bone destruction resembling a cyst. Note also that the teeth which are normally erupted and free from disease are displaced. The apparent space was not caused by the loss of teeth but was created by displacement of the growth.

derived. Even those occurring in identical localities may present distinctive characteristics, so that it is more advisable to study each individual case.

They all seem to have the ability to widely infiltrate the surrounding tissues. After the immediately invaded tissues become broken down, they have a great tendency to spread along the fascia, along the sheaths of vessels, the nerves, and through the invaded bone and other tissues. They are exceedingly vascular, grow rapidly, and often attain very large size. They are generally very susceptible to traumatic injuries and to parasitic infection. Those occurring in the oral cavity often present breaking-down or ulcerative areas, due to inherent sloughing, to trauma caused by opposing teeth, and other irritating factors prevalent in the oral cavity.

Periosteal Sarcomas.

From a clinical standpoint, sarcomatous growths of the oral cavity present widely diverse variations. Of those which occur on the surface and appear to spring from the periosteum, or from the peridental membrane of a tooth, i.e., periosteal sarcomas, two different types are observed. In these the

FIG. 350. The growth presented here occurred in a woman 28 years of age. The surface appearance of all the tissues and the outline of the bone as well as the face was normal. The only symptom was neuralgic pain for three months which seemed to increase progressively. The radiograph shows a destructive alteration in the bone substance, although all of the teeth were firm and those within the area proper were free from disease. It was rather difficult to determine the exact nature of the lesion, which in operation proved to be a sarcoma.

tissues of the sarcoma are clearly exposed upon the surface, and present as highly vascular, lobulated, soft masses of tissue, somewhat loose in structure and with a great tendency to bleed. The second type is likewise a surface growth, and present as a firm, irregularly formed tumor mass, which springs from a broad base with very little invasion of the subjacent structures. These are not quite so vascular as those first described, and their texture suggests that they are composed of fibrous tissue.

Central Sarcomas.

In the second group, the sarcomatous growth does not appear upon the mucous membrane surface but may occur as an ill-defined swelling in any part of the mandible or the maxillæ. There are no disturbing symptoms except that, in the more advanced cases, a nerve trunk may be pressed upon, when vague, neuralgic pains of variable degree are experienced. The covering oral mucosa in itself presents no pathological signs except the swelling caused by the distention of the growth underneath. The teeth in the area usually become loosened and often completely dislodged from their normal position or even become exfoliated. The tissue may become so displaced that biting down of the opposing teeth causes ulceration.

The clinical manifestations of central sarcomas, which develop from the substance of the bone, are often confusing as they do not always present distinct characteristics of sarcomatous growths. The outer surfaces may appear entirely intact and the only sign may be indefinite neuralgic pain, probably caused by pressure upon a nerve trunk within the region. The radiographs indicate that the affected area is completely circumscribed, although upon exposure the growth is not found to be incapsulated. (Figs. 347 and 348.) They often resemble in many respects a cyst, and a differential diagnosis can often be made only by aspiration, or by reflecting at a convenient point the overlying mucous membrane. There are others in which the affected area is not so circumscribed, but there are indications that the bone destruction is still confined to a definable area. (Figs. 349, 350, 351, 352, and 353.)

Third Group.

In the third group, which probably originates in the periosteum, the involvement of the tissues is so advanced that it is hard to determine their point of origin by clinical or radiographic examination. There is a breaking down of the surface tissues, considerable infiltration, and the bone seems to be completely decalcified at some central portion, and from here evidences of the alteration in the bone structure (including the cortical portion), is observed to penetrate in all directions. These often cause destruction of the complete thickness of the bone and fracture. (See pathological fractures.)

Sarcomatous growths occurring in the maxillary sinus cause no disturbing symptoms in the early stages of their development. Their greater insidiousness lies often in the fact that they develop painlessly until they have attained a large size and considerable infiltration has taken place. Slight neuralgic pain may be the first sign noted, which is prone to increase with the pressure upon the infraorbital nerve. With the enlargement of the growth there may be, in the course of time, a thinning out and bulging

of any or all of the walls of the maxillary bone. Crepitation may be discerned upon pressure at points, and there is hemorrhage from the nostril of the affected side. There may be a degree of exophthalmus as the orbital plate is being pressed upon. The degree of facial deformity increases with

Fig. 351. This growth occurred in a man 35 years of age. He complained of very slight pain in the bicuspid region some six months before, and was told to let "sleeping dogs lie." The growth has proven to be a sarcoma. Note the peculiar alteration in the bone structure, the circumscribed character of the lesion and the separation of the teeth. The overlying mucosa, though apparently normal, was slightly swollen. Four years after operation the patient is well.

the expansion of the tumor. The alveolar wall and the teeth contained therein are often displaced downward and outward, and the biting of the opposing teeth may cause irritation or ulceration of the gum tissues.

The oral mucosa appears to be intact in many even advanced cases. This, considered with their apparently slow and painless development, the crepitant bony walls and also the radiograph, may lead one to believe that the condition is a cyst. In all cases of swellings about the jaws and teeth, in which the teeth appear to have erupted and seem normal and have become loose and dislodged, the possibility of malignancy should be considered. The vague neurologic pains which I have come to regard as

almost pathognomonic of malignancy in the presence of tumors, rarely exist in cysts. Aspiration is one of the surest means of diagnosis. In the presence of a cyst the fluid contents of this growth are withdrawn. When a growth is present there is a degree of resistance offered to the penetrating needle and a scant amount of frothy tissue juice is withdrawn. In some

Fig. 352. The same case as Fig. 351 four years after the operation. There is no local sign of recurrence and the patient appears to be well.

very obscure cases it may be necessary to split the overlying mucosa so as to expose the contents at a small point. The growth will be indicated by the presence of lobulated masses of tissue which are characteristic of sarcomatous growths in these regions.

Treatment and Prognosis of Sarcoma.

It is rather difficult to prescribe or even to outline a definite treatment for sarcomatous growths. It may be stated, however, that the location, the extent of infiltration so far as this can be determined by the methods of examination at our command, the degree of malignancy as determined by the histological structures, the age of the patient, the history of the growth, and the extent of bone destruction, should be the guiding factors. Numerous cases metastasize very rapidly and are highly malignant regardless of size. Quite often the extent of invasion can be guessed

FIG. 353. Sarcoma of the maxilla in a young man 20 years of age. The growth most likely originated in the maxillary sinus, as all the bone tissues in the region appeared to be destroyed. The oral mucosa presented no break excepting the invagination caused by the lower teeth and ulceration at this point. The growth was noticed some six months before, but the patient applied for treatment only three weeks before this picture was taken. It was considered then an inoperable condition.

at only during the progress of the operation. Those who undertake to operate upon these cases must be prepared to meet all emergencies. To the experienced, the gross texture of the tissues may indicate the presence of infiltration. Conservative operations are permissible only in sarcomas of the giant cell type or in those where the tumor appears to be well circumscribed. In others the resection must be more radical and an entire maxillary bone or half of the mandible must be removed. The prognosis is rarely favorable. Some are fatally malignant from the beginning. A number of five-, seven-, and even fifteen-year cures have been reported.

Epithelioma.

Epithelioma is a malignant neoplasm which grows from epithelial tissue.

Epithelioma occurs more frequently in the oral cavity and the associated structures than sarcoma. Statistics show that they more often occur in men than in women, although the contrary is true in other regions of the body. They are more frequently observed in the upper than in the lower jaw. No part of the oral mucosa is immune and they may occur upon the inner surface of the cheeks, upon the alveolar ridges, upon the palate, in the floor of the mouth, and upon the pillars of the fauces. The tongue and the lips are frequently the sites for the development of cancer, the lower lip more frequently than the upper. They also occur in the maxillary sinus and the pharynx.

As sarcoma is regarded to be a neoplasm of youth, so epithelioma is a growth of later life. Though cases are seen at earlier ages, they occur more frequently after fifty, the highest per cent being between the ages of sixty and seventy.

The tumor usually originates in some part of the oral mucosa, and, through a process of destructive proliferation, the surrounding tissues and also the bone may become involved. Ewing differentiates two groups of growths according to their derivation:—

(1) Those which are derived from mature normal epithelial cells and through irritation, or through some other unknown factor undergo malignant degeneration.
(2) Those which, according to Cohnheim's theory, are derived from misplaced embryonic cells.

Little is known about the true etiological factors which induce malignant degeneration even after the intensive research work in this field. It is very significant, however, that the pathologist and also the surgeon recog-

nizes a precancerous stage. Ribbert believes that epithelial surface tumors are always preceded by some kind of irritation, caused by chemical, mechanical, or radiating agencies. It is not possible, at the present time, to definitely determine in all cases just where this dividing zone lies, but

Fig. 354. Epithelioma in the upper jaw of a man 55 years of age. The growth extended from the tuberosity to the cuspid region, and to a considerable distance upon the palatal and buccal surfaces.

in many instances there are very early clinical signs and histological changes which definitely mark malignancy. It is probable that in view of the graveness of malignant conditions it is at times more advisable, in doubtful cases, to be inclined towards a radical diagnosis, although Ewing states that numerous reported cured epitheliomas of the tongue were benign papillomas.

Epithelioma of the oral cavity is very frequently associated with some form of trauma or chronic irritation. The most frequently identified are: Irritation of sharp, broken-down or diseased teeth; use of tobacco and snuff; alcohol; the habit of eating too hot or spicy food; other irritating factors such as calcific deposits or ill-fitting dentures, fillings, etc., which are prevalent in the oral cavity. It is often cited that amongst Indians who habitually chew betel nuts cancerous degenerations occur frequently at the

point of irritation. In the face of this we frequently see epithelioma develop at points which are not exposed to direct mechanical irritation and are out of the range of the teeth, as, for instance, the soft palate. Syphilis and leucoplakia are regarded as precancerous or predisposing factors in malignancy.

Fig. 355. Carcinoma of the lower jaw in a man 65 years of age. The growth extended deep down into the sublingual regions of the pharynx. There was marked adenopathy and it was considered to be an inoperable case.

Epithelioma of the tongue is frequently traced to some traumatic injury or chronic irritation producing an ulcer which may later degenerate into a malignant growth.

Epithelioma of the lips is almost invariably ascribed to the irritation caused by the use of a pipe, and it is also often observed in cigarette smokers. Cases have been reported in which an apparently single traumatic injury was followed by malignant degeneration.

Although it is generally recognized that epithelioma does not essentially begin as a malignant growth, it is rather unfortunate that the condition is not always recognized in the precancerous stage. In fact, most cases apply for treatment when the growth has attained an advanced or inoperable

stage. This is frequently due to the patient's negligence and just as frequently to meddlesome treatment by the physician or the dentist.

Epithelioma extends locally by the continuous invasion of the cancerous growth into the surrounding tissues. There may be considerable induration and inflammation. The inflammatory condition may act either as a barrier to further infiltration, or may just favor the extension of the growth. There may be considerable hyperplasia due to the active proliferation of the cancerous tissue. In the more advanced stages they generally break down, forming an extensive sloughing surface, deep induration and destruction of the subjacent tissues. Epitheliomas may metastasize through the blood and lymph channels but they more frequently do so through the lymphatics. Cervical lymphadenitis is observed in early stages, after metastasis has taken place. Metastasis is very often embolic and all lymphatic and lymph-bearing tissues are regarded with suspicion, even in the absence of palpable glands. It is maintained and was first suggested by Crile that the metastasis rarely penetrates beyond the lymphatics of the neck.

The treatment as advocated at the present time consists of radical surgery combined with radium or deep X-ray therapy. In the operation the complete growth and a considerable zone of what appears to be healthy tissue, as well as all the lymphatic and lymph-bearing tissues of the neck, are removed.

Fig. 354 is an example of a case of epithelioma of the upper jaw which occurred in a man fifty-five years of age. He went to a dentist (about three months before I first saw the case) with the complaint that for some few weeks the second molar had been annoying him. The dentist found that the tooth proper was free from disease but that it was loose in its socket and was surrounded by what appeared to be granulation tissue. This was confined to the immediate surroundings of the tooth and he curetted it away, down to the bone. The condition would not heal, and about three weeks later he curetted again. He soon noticed that the condition was spreading. When I first saw him, the growth extended as shown in the photograph, from the tuberosity to the cuspid region and to considerable distance upon the palatal and buccal surfaces. There were several palpable glands on the affected side at that time.

Fig. 355 is a carcinoma of the lower jaw in a man sixty-five years of age. Though he experienced a degree of discomfort, he never applied for medical aid until this advanced condition developed. The growth extended deep down into the sublingual regions to the pharynx; there was a marked adenopathy, and it was considered to be an inoperable case.

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